code of federal regulations

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Transportation

ORIGINAL

COMPLETED

49

PARTS 178 TO 199

Revised as of October 1, 1981

022-003-94696-9

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code of federal regulations

Transportation

49

PARTS 178 to 199

Revised as of October 1, 1981

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Title 1 through Title 16	as of January 1
Title 17 through Title 27	as of April 1
Title 28 through Title 41	as of July 1
Title 42 through Title 50	as of October 1

The appropriate revision date is printed on the cover of each volume.

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JOHN E. BYRNE,
Director,
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Title 49—Transportation is composed of eight volumes. The contents of these volumes represent all current regulations codified under this title of the CFR as of October 1, 1981.

The parts in these volumes are arranged in the following order: Parts 1-99, Subtitle A—Office of the Secretary of Transportation; Parts 100-177 and Parts 178-199, Chapter I—Research and Special Programs Administration (DOT); Parts 200-399, Chapter II—Federal Railroad Administration (DOT), and Chapter III—Federal Highway Administration (DOT); Parts 400-999, Chapter IV—Coast Guard (DOT), Chapter V—National Highway Traffic Safety Administration (DOT), Chapter VI—Urban Mass Transportation Administration (DOT), Chapter VIII—National Transportation Safety Board, and Chapter IX—United States Railway Association; Parts 1000-1199, Parts 1200-1299, and Part 1300 to End, all Chapter X—Interstate Commerce Commission.

All volumes except Parts 1-99 contain redesignation tables. In the volume containing Parts 100-177 see § 172.101 for the Hazardous Materials Table. Parts 200-399 of this title contain the Federal Motor Carrier Safety Regulations, and a Subject Index to these regulations follows Chapter III. The Federal Motor Vehicle Safety Standards appear in Part 571.

For this volume Clarietha T. English was Chief Editor assisted by Beth R. Carter. The Code of Federal Regulations publication program is under the editorial direction of Martha B. Girard, assisted by Robert E. Jordan.

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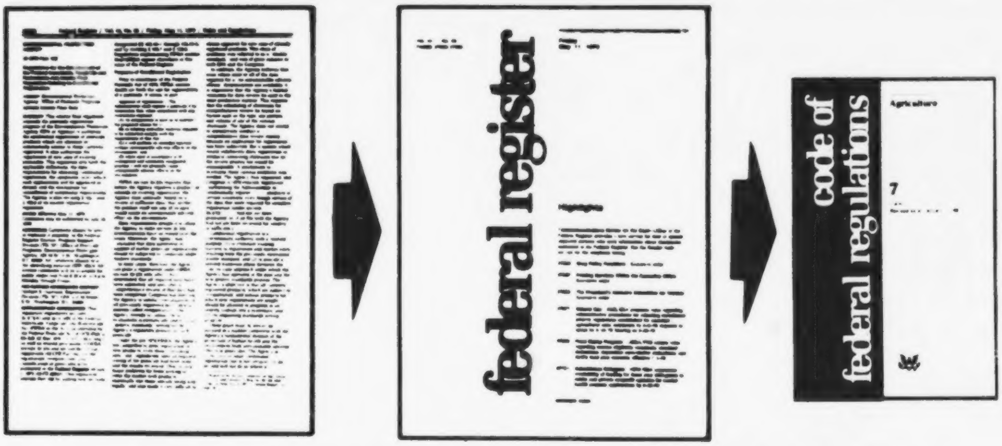

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Title 49—Transportation

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EDITORIAL NOTE: For a document which shows editorial changes and corrections in this chapter, see 35 FR 13835, Sept. 1, 1970.

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APPENDICES TO PART 178

APPENDIX A—SPECIFICATIONS FOR STEEL
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AUTHORITY: 49 U.S.C. 1804, 1808; 49 CFR 1.53(e), unless otherwise noted.

NOTE: Nomenclature changes to Part 178 appear at 43 FR 36446 (Amdt. 178-49), Aug. 17, 1978, 43 FR 48645, Oct. 19, 1978 (Amdt. 178-51), and 44 FR 55577, Sept. 27, 1979 (Amdt. 178-57).

§ 178.0 Purpose, scope, and applicability.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[Amdt. 178-40, 42 FR 2689, Jan. 13, 1977]

§ 178.0-1 Purpose and scope.

This part prescribes the manufacturing and testing specifications for packaging and containers used for the transportation of hazardous materials in commerce.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[Amdt. 178-40, 42 FR 2689, Jan. 13, 1977]

§ 178.0-2 Applicability.

(a) Any person who performs a function prescribed in this part, shall perform that function in accordance with this part.

(b) When this part requires (either expressly or by reference to § 173.24 of this subchapter) a packaging or container to be marked with a DOT specification (for example, DOT-1A, DOT-17E-304HT, DOT-23G40), compliance with that requirement is the responsibility of the packaging or container manufacturer. Marking the packaging or container with the DOT specification shall be understood to certify compliance by the manufacturer, that the functions performed by the manufacturer, as prescribed in this part, have been performed in compliance with this part. (See also § 173.28 of this subchapter, "Reuse of containers." That section envisions the marking of containers to be performed by a person other than the original manufacturer.)

(c) Except as specifically provided in §§ 178.337-18 and 178.340-10, the manufacturer of a packaging or container should inform each person to whom that packaging or container is transferred of any specification requirements which have not been met at time of transfer.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[Amdt. 178-40, 42 FR 2689, Jan. 13, 1977, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.0-3 United Nations symbol and packaging identification code.

(a) In addition to the markings required by this subchapter, packagings may be marked with the United Nations symbol and packaging identification code as provided in Annex 1 of the IMCO Code, provided the person applying these markings has established that the packaging conforms to the applicable provisions of Annex 1 of the IMCO Code.

(1) If an indication of the country in which tests have been carried out is required, the letters "USA" shall be used.

(2) If an indication of "the name of the manufacturer or other identification of the packaging as specified by the competent authority" is required, the name and address or symbol of the person making the mark shall be entered. Symbols, if used, must be registered with the Associate Director for OE. Duplicate symbols are not authorized.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-63, 45 FR 62083, Sept. 18, 1980]

Subpart A—Specifications for Carboys, Jugs in Tubs, and Rubber Drums

SOURCE: 29 FR 18813, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§ 178.1 Specification 1A; boxed carboys.

Glass, earthenware, clay, or stoneware.

§ 178.1-1 Compliance.

(a) Required in all details.

§ 178.1-2 Reuse of packages.

(a) Parts of outside container and cushioning must be replaced when broken, decayed, or inefficient in any way.

(b) Carboys with lip cracked or badly chipped not authorized; gasket seat must be even. Packages must be capable of passing tests prescribed in § 178.1-9.

§ 178.1-3 Closing devices required.

(a) As follows except when otherwise authorized in the packing regulations:

(1) Acidproof stoppers or other devices with gaskets, securely fastened; venting closures are required when necessary to prevent internal pressure in excess of 8 pounds per square inch gauge at 130° F.

(2) Glass stoppers around to fit and securely fastened are authorized when internal pressures do not exceed 8 pounds per square inch gauge at 130° F.

§ 178.1-4 Capacity and marking of carboy.

(a) Containers 5 to 13 gallons are classed as carboys. Must be embossed to indicate maker and year of manufacture; mark of maker to be registered with the Associate Director for OE.

§ 178.1-5 Class carboys.

(a) Thoroughly annealed; top of lip smooth and even; must contain at least 20 pounds of glass of 12-gallon carboys and 21 pounds for 13-gallon carboys. Glass in side walls should be well distributed and at least ¹⁄₁₆" thick. Defective carboys not authorized.

§ 178.1-6 Earthenware, clay, or stoneware carboys.

(a) Of acidproof material.

§ 178.1-7 Outside containers.

(a) Wooden boxes completely enclosing body of carboy or wooden boxes completely enclosing body and neck of carboy, with 4 vertical corner posts, two cleats for shoes and two carrying cleats. (See paragraph (e) of this section.)

(b) Lumber to be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

(c) Assemble sides and ends with grain of wood horizontal and nail as specified. Nail bottom to sides and ends; fasten top by any efficient means. Cleats for shoes to be along edges of bottom parallel to carrying cleats. (See paragraph (e) of this section.)

(d) Parts and dimension as follows:

Nominal carboy capacity not over (gallons)	Minimum dimensions			Nails—sides and bottom	
	Thickness sides, top, bottom and ends	Vertical corner posts	Carrying cleats and shoes[1]	Size not less than[2]	Spacing average not over[3]
	Inch	*Inches*	*Inches*	*Penny*	*Inches*
5 to 7	⅝	⅝×2½	⅝×1⅞	7	2¼
				6	2
from 7 to 13	²⁵⁄₃₂	²⁵⁄₃₂×3⅛	²⁵⁄₃₂×2¹¹⁄₃₂	9	2¾
				8	2½

[1] Other dimensions with equal cross section acceptable.

[2] Screws of equal efficiency authorized.

[3] Spacing 6 inches acceptable along edge grain of bottoms.

(e) In place of bottom cleats, the following is authorized: 2 angle irons at least 1¼" × 1¼" × ¹⁄₁₆", applied across grain of bottom boards from corner to corner, supported by acid resistant metal corner supports securely fastened to sides and ends at each bottom corner so as to raise bottom boards of box at least ¾" above bottom of corner supports; nailing along end grain of bottom boards not required.

(f) Special box. Must comply with this specification except as follows: Bottom of box must be nailed to 4 nailing cleats which form part of the sides and ends of box. Top of box must be reinforced by 2 cleats of ½-inch lumber 4 inches wide, extending the entire width of the top at right angles to the sides of the boards forming the top; a vacant space of 1 inch between outside edge of top and cleat should be allowed for nailing top to box; parts and dimensions must be as follows:

Carboy capacity, not over (gallons)	Minimum dimensions					Nails, sides, and bottom	
	Thickness of sides, top, and ends	Thickness of bottom	Thickness and width of bottom nailing cleats	Carrying cleats and shoes	Triangular vertical corner posts	Size not less than[1]	Spacing average not over[2]
	Inch	*Inches*	*Inches*	*Inches*	*Inches*	*Penny*	*Inches*
5 to 13	⅛	25/32	25/32 by 2⅛ (short sides)	25/32 by 2½	2½ by 2½	8	2⅛
						10	2¾

[1] Screws of equal efficiency authorized.
[2] Spacing 6 inches acceptable along edge grain of bottoms.

(g) *Cushioning materials.* Cushioning devices or materials must be of such type, or be so secured within the outer container, that the carboy cannot shift in a way that cushioning efficiency is reduced.

§ 178.1-8 Marking of outside container.

(a) On each container with letters and figures at least ¾ inch high applied by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) DOT-1A.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38180, Sept. 9, 1976]

§ 178.1-9 Tests.

(a) *Apparatus—Standard required.* Detailed prints may be obtained from the Associate Director for HMR.

(b) *Method.* Fill with water to lower edge of neck; swing 55" measured from wall to nearest bottom edge of basket:

(1) Side shock; test at least 10 carboys.

(2) Bottom shock; test at least 6 carboys.

NOTE 1: In instances where 99 or less carboys are in service during either 6-month period of the year it shall be acceptable to test 10 percent of the total but no less than 3 carboys on both the side and bottom swing. If this provision is used, the report of test results must so state.

(c) *Acceptable results.* 90 percent of carboys must not break under side shock and same for bottom shock, except both results must be 100 percent if modified test authorized by Note 1 of paragraph (b) of this section is used.

(d) *When required.* By each manufacturer, at intervals not to exceed 6 months; separate tests are required for:

(1) New packages (those with new outside container).

(2) Used packages.

(3) Packages with carboys differing over 2 gallons.

(4) Packages differing in kind of cushioning.

(e) *Exception.* Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

(f) *Reports.* Required to be made to Associate Director for OE on form as follows:

REPORT OF TESTS OF CARBOYS

(As required by D.O.T. Regulations and Specifications)

(Place) ——————————
(Date) ——————————
Test made for ——————————

——————————

(Give name and address of plant for which tests were made)

Description of package	Results		
	Number of test	55-inch swing	
		Side	Bottom
Capacity	1		
Condition[1]	2		
	3		
Type of inside container[2]	4		
	5		
Cushioning[3]	6		
	7		

Description of package	Results		
	Number of test	55-inch swing	
		Side	Bottom
Diameter of bottle	8		
	9		
Size of outside container	10		
(inside)	11		
	12		
Capacity	13		
Condition [1]	14		
	15		
Type of inside container [2]	16		
	17		
Cushioning [3]	18		
	19		
Diameter of bottle	20		
	21		
Size of outside container	22		
(inside)	23		
	24		

Specification mark is
Identification symbol is
Remarks

(Signature)
(Per)

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[1] State whether outside container is new or used.

[2] State whether glass, earthenware, etc.

[3] State whether hay, mineral wool, ground cork, excelsior, wood strips —— type, cork pads ——type, etc.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66197, Nov. 19, 1979]

§ 178.1-10 Boxes of veneer, plywood and laminated wood.

(a) Boxes of veneer, plywood, laminated wood, or any combination thereof, which comply with this section (except § 178.1-7 (a), (c), and (d)), are authorized provided:

(1) Outside containers shall completely enclose body of carboy or body and neck of carboy.

(2) That these boxed carboys pass the regular test prescribed in § 178.1-9. A copy of the most recent test report must be retained until further tests are made or for five years from the date of test.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66197, Nov. 19, 1979]

§§ 178.2-178.3 [Reserved]

§ 178.4 Specification 1D; boxed glass carboys.

§ 178.4-1 Compliance.

(a) Required in all details.

§ 178.4-2 Reuse of packages.

(a) Parts of outside container and cushioning must be replaced when broken, decayed, or inefficient in any way.

(b) Carboys with lip cracked or badly chipped not authorized; gasket seat must be even. Packages must be capable of passing tests prescribed in § 178.4-8.

§ 178.4-3 Closure.

(a) Threaded screw cap which shall be constructed of a suitable plastic or other material resistant to lading.

(b) Gasket or lining for cap must be used and shall be resistant to lading and:

(1) Must be liquid tight or;

(2) Must be liquid tight up to venting pressure when such venting is prescribed for the material which is to be shipped.

(c) At least one complete continuous thread must be engaged with gasket in place.

§ 178.4-4 Capacity and marking of carboy.

(a) *Capacity.* 6.5 United States gallons nominal capacity, 7.0 United States gallons overflow, tolerance plus or minus 10 fluid ounces.

(b) *Marking.* Each carboy bottle must be embossed in bottom as follows:

Maker's mark (to be registered with Associate Director for OE.)
Year of Manufacture
DOD-1D

§ 178.4-5 Glass carboy bottle.

(a) Must be machine-blown, thoroughly and properly annealed, with screw thread finish having at least one continuous thread to accommodate closure; top of lip smooth and even; must contain 14 pounds of glass, tolerance minus 8 ounces plus 16 ounces. Minimum thickness to be .075 inch. Defective carboys not authorized.

§ 178.4-6 Outside containers.

(a) Wooden boxes completely enclosing body and neck of carboy, with 4 vertical corner posts, two cleats for shoes and two carrying cleats. An opening not exceeding 3 inches in width may be provided directly above the neck of bottle, if the top of the box is made up of not more than two pieces of lumber of $\frac{25}{32}$ inch thickness. Bottom board of the two ends of the box must be constructed of lumber at least one inch thick, must be flush with the carrying cleats and be at least 2¾ inches in width. Cleats or other fasteners used to secure cover must not extend beyond carrying cleats.

(b) Lumber to be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

(c) Assemble sides and ends with grain of wood horizontal and nail as specified. Nail bottom to sides and ends; fasten top by any efficient means (friction closure not authorized). Cleats for shoes to be along edges of bottom parallel to carrying cleats and at right angle to the direction of bottom board or boards.

(d) Parts and dimensions as follows:

Carboy capacity, nominal not over (gallons)	Minimum dimensions			Nails—Sides and bottom [4]	
	Thickness—Sides, top, bottom, and ends [1]	Vertical corner posts [2]	Carrying cleats and shoes [3]	Size	Spacing average [5]
	Inch	*Square Inches*	*Inches*	*Penny*	*Inches*
6.5	½	2.0	½ × 2¾	6	2

[1] Except as prescribed or permitted under § 178.4-6(a).

[2] Cross sectional area.

[3] Other dimensions with equal cross section acceptable, in lieu of separate carrying cleats, side board, at point where cleat should be located, may be constructed of lumber not less than one inch thick so that overhang will be at least ½ inch.

[4] Screws of aqual efficiency authorized.

[5] Spacing 6 inches acceptable along edge grain of bottoms.

(e) *Cushioning materials.* Cushioning devices or materials must be of such type, or be so secured within the outer container, that the carboy cannot shift in a way that cushioning efficiency is reduced.

§ 178.4-7 Marking of outside container.

(a) On each container with letters and figures at least ¾ inch high applied by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) DOT-1D.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38180, Sept. 9, 1976]

§ 178.4-8 Tests.

(a) *Apparatus—Standard required.* Detailed prints may be obtained from the Associate Director for HMR.

(b) *Method.* Fill with water to lower edge of neck; swing 55" measured from wall to nearest bottom edge of basket:

(1) Side shock; test at least 10 carboys.

(2) Bottom shock, test at least 5 carboys.

NOTE 1: In instances where 99 or less carboys are in service during either 6-month period of the year it shall be acceptable to test 10 percent of the total but not less than 3 carboys on both the side and bottom swing. If this provision is used, the report of test results must so state.

(c) *Acceptable results.* 90 percent of carboys must not break under side shock and same for bottom shock, except both results must be 100 percent if modified test authorized by Note 1 of paragraph (b) of this section is used.

(d) *When required.* By each manufacturer, at intervals not to exceed 6 months; separate tests are required for:

(1) New packages (those with new outside container).

(2) Used packages.

(3) Packages differing in kind of cushioning.

(e) *Exception.* Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

(f) *Reports.* Required to be made to Associate Director for OE on form as follows:

REPORT OF TESTS OF CARBOYS

(As required by D.O.T. Regulations and Specifications)

(Place) ____________________

(Date) ____________________

Test made for ____________________

____

(Give name and address of plant for which tests were made)

Description of package	Results		
	Number of test	55-inch swing	
		Side	Bottom
Capacity	1		
Condition [1]	2		
	3		
Type of inside container [2]	4		
	5		
Cushioning [3]	6		
	7		
Diameter of bottle	8		
	9		
Size of outside container	10		
(inside)	11		
	12		
Capacity	13		
Condition [1]	14		
	15		
Type of inside container [2]	16		
	17		
Cushioning [3]	18		
	19		
Diameter of bottle	20		
	21		
Size of outside container	22		
(inside)	23		
	24		

Specification mark is ....

Identification symbol is ....

Remarks....................

....

....

(Signature) ....

(Per)....................

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[1] State whether outside container is new or used.

[2] State whether glass, earthenware, etc.

[3] State whether hay, mineral wool, ground cork, excelsior, wood strips —— type, cork pads ——type, etc.

(g) *Internal pressure test.* Bottles shall be capable of withstanding a sustained internal pressure of 20 psig for a 15-day period.

(h) *Hydrostatic pressure test.* One bottle selected at random from each 200 produced on each mold shall be subjected to an instantaneous hydrostatic pressure test to bursting. Pressure at which bottle bursts must not be less than 40 p.s.i. gauge. If bottle so tested fails at a pressure less than 40 p.s.i., 12 additional samples must be selected from the same lot of 200 bottles and tested in the same manner. All 12 samples must pass required test otherwise entire lot shall be rejected.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§ 178.5 Specification 1X; boxed carboys, 5 to 6½ gallons, for export only.

Glass, earthenware, clay, or stoneware. Single-trip container.

§ 178.5-1 Compliance.

(a) Required in all details.

§ 178.5-2 Closing devices required.

(a) As follows except when otherwise authorized in the packing regulations:

(1) Acidproof stoppers or other devices, with gaskets, securely fastened; venting closures are required when necessary to prevent internal pressure in excess of 8 pounds per square inch gauge at 130° F.

(2) Glass stoppers ground to fit and securely fastened are authorized when internal pressures do not exceed 8 pounds per square inch gauge at 130° F.

(3) For box: Two flat metal nailless straps, at least ⅝ inch by 0.020 inch, encircling top, sides, and bottom and securely sealed, are required.

§ 178.5-3 Capacity and marking of carboy.

(a) Containers must be 5 to 6½ gallon size and embossed to indicate maker and year of manufacture.

§ 178.5-4 Glass carboys.

(a) Thoroughly annealed; top of lip smooth and even. Glass in side walls should be well distributed and at least 1/16 inch thick. Defective carboys not authorized.

§ 178.5-5 Earthenware, clay, or stoneware carboys.

(a) Earthenware, clay, or stoneware carboys of acidproof material.

§ 178.5-6 Outside containers.

(a) Wooden boxes completely enclosing body and neck of carboy, with 4 vertical corner posts. Top may consist of cap fitting snugly inside body of box and resting on corner posts.

(b) Lumber to be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

(c) Assemble sides and ends with grain of wood horizontal and nail as specified; nail bottom to ends; fasten top by any efficient means.

(d) *Parts and dimensions.* Sides, top, and bottom at least ½ inch thick; vertical corner posts at least 2.25 square inches cross section; nails at least 6-penny at 2-inch intervals or 5-penny at 1¾-inch intervals.

(e) *Cushioning materials.* Cushioning devices or materials must be of such type, or be so secured within the outer container, that the carboy cannot shift in a way that cushioning efficiency is reduced.

§ 178.5-7 Marking of outside container.

(a) On each container with letters and figures at least ¾ inch high applied by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) DOT-1X.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38180, Sept. 9, 1976]

§ 178.5-8 Marking.

(a) Each outside container must also be plainly marked "FOR EXPORT ONLY, NOT RETURNABLE" and the top must be marked "THIS SIDE UP".

§ 178.5-9 Tests.

(a) *Apparatus—Standard required.* Detailed prints may be obtained from the Associate Director for HMR.

(b) *Method.* Fill with water to lower edge of neck; swing 55" measured from wall to nearest bottom edge of basket:

(1) Side shock; test at least 10 carboys.

(2) Bottom shock; test at least 5 carboys.

(c) *Acceptable results.* 90 percent of carboys must not break under side shock; same for bottom shock.

(d) *When required.* By each manufacturer, at intervals not to exceed 6 months; separate tests are required for:

(1) New packages (those with new outside container).

(2) Packages differing in kind of cushioning.

(e) *Exception.* Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

(f) *Reports.* Required to be made to Associate Director for OE on form as follows:

REPORT OF TESTS OF CARBOYS

(As required by D.O.T. Regulations and Specifications)

(Place) ——————————
(Date) ——————————
Test made for ——————————

——————————————————
(Give name and address of plant for which tests were made)

Description of package	Results		
	Number of test	55-inch swing	
		Side	Bottom
Capacity	1		
Condition[1]	2		
	3		
Type of inside container[2]	4		
	5		
Cushioning[3]	6		
	7		
Diameter of bottle	8		
	9		
Size of outside container	10		
(inside)	11		
	12		
Capacity	13		
Condition[1]	14		
	15		
Type of inside container[2]	16		
	17		
Cushioning[3]	18		
	19		
Diameter of bottle	20		
	21		

Description of package	Results		
	Number of test	55-inch swing	
		Side	Bottom
Size of outside container	22	....	....
(inside)	23	....	....
	24	....	....

Specification mark is ....

Identification symbol is ....

Remarks..

....

....

(Signature) ....

(Per)..

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[1] State whether outside container is new or used.

[2] State whether glass, earthenware, etc.

[3] State whether hay, mineral wool, ground cork, excelsior, wood strips —— type, cork pads —— type, etc.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§ 178.6 Specification 1EX; glass carboys in plywood drums.

Single trip container.

§ 178.6-1 Compliance.

(a) Required in all details.

§ 178.6-2 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

§ 178.6-3 Closing devices required.

(a) As follows except when otherwise authorized in the packing regulations:

(1) Acidproof stoppers or other devices, with gaskets, securely fastened; venting closures are required when necessary to prevent internal pressure in excess of 8 pounds per square inch gauge at 130° F.

(2) Glass stoppers ground to fit and securely fastened are authorized when internal pressures do not exceed 8 pounds per square inch gauge at 130° F.

§ 178.6-4 Capacity and marking of carboy.

(a) Containers must be 5 to 6½ gallons capacity and embossed to indicate maker and year of manufacture.

§ 178.6-5 Glass carboys.

(a) Thoroughly annealed; top of lip smooth and even. Glass in side walls should be well distributed and at least 1/16 inch thick. Defective carboys not authorized.

§ 178.6-6 Outside containers.

(a) Plywood drums completely enclosing body and neck of carboy and constructed as follows:

(1) *Body shell.* To be of two plies of hardwood veneer, each not less than 1/12 inch in thickness, firmly glued together, with the grain of the outside ply parallel and the inner ply vertical to the heads. The body shall be butt-jointed and shall be fastened on the outside with a 28-gauge steel strip, not less than 1½ inches in width. 17-gauge staples shall be driven on each side of the joint, spaced not more than 1½ inches apart and clinched on inside of the body.

(2) *Heads.* Top and bottom heads shall be of three ply hardwood veneer, each ply not less than 1/12 inch in thickness, all firmly glued together, with the grain of each outer ply at right angles to the grain of the center ply. Each head shall be circled to fit snugly inside of the body. Interior heads shall be of the same construction.

(3) *Hoops.* To be of hardwood veneer, not less than 1¾ inches wide by ⅛ inch thick. Hoops shall be fastened to the body by 17-gauge staples on not less than 3 inch centers and shall be overlapped not less than 3 inches.

(4) *Head liners.* When plywood cushioning is used the inner lining strips which support the plywood cushion shall be of hardwood veneer not less than ⅕ inch in thickness and ⅝ inch in width and shall butt or slightly gap. All other head lining strips shall be made of hardwood veneer not less than ⅕ inch in thickness and ⅝ inch in width and shall overlap not less than 3 inches. The bottom head liner and the inside liner strips for the false head and support of the top head shall be fastened by 17-gauge staples on not less than 3 inch centers. The staples shall be driven through the outer hoop and body and clinched on

the inside of the veneer strips; except that the strips holding the false head shall have staples only through the body shell and liner. The top liner which forms the final closure shall be fastened to the body by 14-gauge staples driven through the head liner and body into the outer hoop on not less than 4 inch centers.

(5) *Battens.* A ⅝ inch by 2 inch batten shall be applied to top and bottom and shall be secured at each end by two nails driven through the hoops and shell.

(b) *Cushioning materials.* Cushioning devices or materials must be of such type, or be so secured within the outer container, that the carboy cannot shift in a way that cushioning efficiency is reduced.

§ 178.6–7 [Reserved]

§ 178.6–8 Marking of outside container for compliance with specification.

(a) On each container with letters and figures at least ¾ inch high applied by hot branding iron or printing ink of a color sharply contrasting to background of package with high pressure dies as follows:

(1) DOT-1EX.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–40, 41 FR 38180, Sept. 9, 1976]

§ 178.6–9 Marking of outside container for use.

(a) Each outside container must also by plainly marked "SINGLE-TRIP CONTAINER" just above or below the mark specified in § 178.6–8(a)(1) of this part.

§ 178.6–10 Tests.

(a) *Apparatus—Standard required.* Detailed prints may be obtained from the Associate Director for HMR.

(b) *Method.* Fill with water to lower edge of neck; swing 55" measured from wall to nearest bottom edge of basket:

(1) Side shock; test at least 10 carboys.

(2) Bottom shock; test at least 5 carboys.

NOTE 1: In instances where 99 or less carboys are in service during either 6-month period of the year it shall be acceptable to test 10 percent of the total but not less than 3 carboys on both the side and bottom swing. If this provision is used, the report of test results must so state.

(c) *Acceptable results.* 90 percent of carboys must not break under side shock and same for bottom shock, except both results must be 100 percent if modified test authorized by Note 1 of paragraph (b) of this section is used.

(d) *When required.* By each manufacturer, at intervals not to exceed 6 months; separate tests are required for:

(1) New packages (those with new outside containers).

(2) Packages differing in kind of cushioning.

(e) *Exception.* Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

(f) *Reports.* Required to be made to Associate Director for OE on form as follows:

REPORT OF TESTS OF CARBOYS

(As required by D.O.T. Regulations and Specifications)

(Place) ————————————

(Date) ————————————

Test made for ————————————

————————————————

(Give name and address of plant for which tests were made)

Description of package	Results		
	Number of test	55-inch swing	
		Side	Bottom
Capacity	1		
Condition [1]	2		
	3		
Type of inside container [2]	4		
	5		
Cushioning [3]	6		
	7		
Diameter of bottle	8		
	9		
Size of outside container	10		
(inside)	11		
	12		
Capacity	13		

Description of package	Results		
	Number of test	55-inch swing	
		Side	Bottom
Condition [1]	14		
	15		
Type of inside container [2]	16		
	17		
Cushioning [3]	18		
	19		
Diameter of bottle	20		
	21		
Size of outside container	22		
(inside)	23		
	24		

Specification mark is ....

Identification symbol is ....

Remarks..................

....

....

(Signature) ....

(Per)..................

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[1] State whether outside container is new or used.

[2] State whether glass, earthenware, etc.

[3] State whether hay, mineral wool, ground cork, excelsior, wood strips —— type, cork pads ——type, etc.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§§ 178.7-178.12 [Reserved]

§ 178.13 Specification 1H; polyethylene carboys in low carbon steel or other equally efficient metal crates.

§ 178.13-1 Compliance.

(a) Required in all details.

§ 178.13-2 Capacity and marking of carboy.

(a) Containers 5 to 13 gallons capacity are classed as carboys. Actual capacity must be marked capacity plus 5 percent minimum. Must be permanently marked to indicate marked capacity, maker (symbols, if used, must be registered with the Associate Director for OE), month and year of manufacture, and DOT-2T in figures and letters at least ¼ inch high.

§ 178.13-3 Polyethylene carboys.

(a) Carboys shall be made of polyethylene with no plasticiers or additives and have a maximum melt index value of 2.5 grams per 10 minutes as determined in accordance with method acceptable to the Bureau of Explosives. Carboys must have a minimum weight and wall thickness in accordance with the following table:

Marked capacity	Minimum wall thickness	Minimum weight of bottles
Gallons	*Inch*	*Pounds*
5	1/16	3
6	1/16	4
13	1/16	8

(b) Closing device shall be of material resistant to the lading and adequate to prevent leakage. Opening for closure shall not be over 3½ inches in diameter.

(c) Polyethylene carboys, as manufactured and filled to marked capacity with a material which remains in a liquid form, shall be capable of withstanding a 4-foot drop without leakage, after prior conditioning so that contents will be 0° F. or colder, onto solid concrete on any portion of the carboy.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§ 178.13-4 Outside containers.

(a) Metal crates:

(1) Specifications for each size container must be kept on file by each manufacturer.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§ 178.13-5 Marking of outside container.

(a) Each outside container must be plainly marked by attachment of a metal plate, or permanent marking in contrasting color directly on the polyethylene carboy in a visible area. Marking must be in letters and figures at least ¾ inch high and must be by embossing or stamping when applied on metal plates. Marking must be as follows:

(1) DOT-1H.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark.

Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38180, Sept. 9, 1976]

§ 178.13-6 Tests.

(a) One sample, taken at random and with inner container filled to marked capacity with water and closed as for use, shall be capable of withstanding prescribed tests without leakage or serious rupture of outer container. Tests shall be made of each size by each company starting production. The type tests are as follows:

(1) Complete package must be capable of withstanding 2 drops from a height of 4 feet onto solid concrete, the first drop to be made diagonally so top corner will strike the concrete; the second drop onto a 2-inch by 6-inch timber resting on the concrete with the 6-inch leg vertical, the drop being made with the package in a horizontal position and at right angles to the timber so that impact is near the center of the crate side-wall members.

§ 178.14 Specification 1K; glass carboys cushioned with expandable polystyrene in wooden wirebound box outside containers.

§ 178.14-1 Reuse of packages.

(a) Top, base or side sections of outside contained and cushioning must be replaced when broken, decayed, or inefficient in any way.

(b) Carboys with lip cracked or badly chipped not authorized; gasket seat must be even. Packages must be capable of passing tests prescribed in § 178.14-8.

§ 178.14-2 Closing devices required.

(a) As follows except when otherwise authorized in the packing regulations:

(1) Acidproof stoppers or other devices, with gaskets, securely fastened; venting closures are required when necessary to prevent internal pressure in excess of 8 pounds per square inch gauge at 130° F.

(2) Glass stoppers ground to fit and securely fastened are authorized when internal pressures do not exceed 8 pounds per square inch gauge at 130° F.

(b) For carboys with threaded closure finishes the threaded cap shall be constructed of a suitable plastic or other material resistant to lading.

(1) Gasket or lining must be used and shall be resistant to lading.

(2) Cap must be liquid tight or;

(3) Must be liquid tight up to venting pressure when such venting pressure is prescribed for the material to be shipped.

(4) At least one complete continuous thread must be engaged with gasket in place.

[29 FR 18813, Dec. 29, 1964, as amended by Order 66, 30 FR 5748, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.14-3 Capacity and marking of carboy.

(a) Containers 5 to 13 gallons are classed as carboys; must be embossed to indicate maker and year of manufacture; mark of maker to be registered with the Associate Director for OE.

[Order 66, 30 FR 5748, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.14-4 Bottles.

(a) 13-gallon carboys. Must be thoroughly annealed; top of lip smooth and even; must contain at least 21 pounds of glass. Glass in sidewalls should be well distributed and at least 1/16 inch thick.

(b) 6½-gallon carboys. Must be machine-blown, thoroughly and properly annealed, with screw thread finish having at least one continuous thread to accommodate closure; top of lip smooth and even; must contain 14 pounds of glass, tolerance minus 8 ounces plus 16 ounces. Minimum thickness to be 0.075 inch. Defective carboys not authorized.

[Order 66, 30 FR 5748, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.14-5 Cushions.

(a) Expandable polystyrene, molded to produce a completely fused closed cell structure and designed as to provide a snug fit in all areas of contact with the inside container, in the following forms:

(1) Formed in place around the inside container; density 1.25 plus or minus 0.25 pounds per cubic foot, minimum thickness of sidewalls 1 inch and of bottoms 1.5 inches.

(2) Preformed cushions, one top and one bottom; density 2.75 plus or minus 0.5 pounds per cubic foot, minimum thickness of sidewalls 1 inch and of bottoms 1.37 inches.

(b) Assembled containers must be capable of passing tests prescribed in § 178.14-8.

§ 178.14-6 Outside containers.

(a) Wooden wirebound boxes completely enclosing body of carboy or completely enclosing body and neck of carboy.

(b) Lumber shall be as follows:

(1) Lumber shall be well seasoned and commercially dry; free from decay, objectionable knots, slanting shakes, sharp cross grain, and other defects that materially lessen the strength. Grain of wood in cleats and battens must not cross piece within its length.

(2) Authorized tolerances; cleats, battens and handles, minus 1/32 inch; single thickness veneer minus 5 percent; resawn boards, 1/32 inch below specified thickness for boards 1/4 inch or more thick.

(3) Woods authorized are in the following groups:

GROUP 2

Southern yellow pine.
Hemlock.
North Carolina pine.
Douglas fir.
Larch (Tamarack).

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black ash.
Black gum.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
White ash.
Hickory.

(4) Where plywood is authorized, it must be exterior grade moisture-resistant type.

(c) Binding wires and staples shall be as follows:

(1) Galvanized coated annealed steel or other material of equal strength, Washburn and Moen sizes.

(d) Minimum construction requirements for 13-gallon carboys shall be as follows:

Wirebound boxes	Square box for preformed cushions	Octagonal box for preformed cushions	Cylindrical box for preformed cushions	Octagonal box for formed-in-place cushions
Faceboard thickness (sides only—without handle cleats)				
Group 2 woods	5/16″	5/16″	5/16″	1/4″.
Groups 3 and 4 woods	1/4″	1/4″	5/16″	1/4″.
Faceboard thickness (sides only—with handle cleats)				
Group 2 woods	3/8″	3/8″	5/16″	1/4″.
Group 3 woods	5/16″	5/16″	5/16″	1/4″.
Cleats	1 3/16″×7/8″	1 3/16″×7/8″	1 3/16″×5/8″	1 3/16″×7/8″.
Handle cleat	2 1/8″×7/8″	2 1/8″×7/8″	None	2 1/8″×7/8″.
Binding wires				
Number and gauge over outside cleats.	2-12 gauge	2-12 gauge	2-12 gauge	2-12 gauge.
Number and gauge intermediate wires.	3-13 gauge	3-13 gauge	2-12 gauge	2-13 gauge.
Staples	1 1/4″-16 gauge	1 1/4″-16 gauge	1″-16 gauge	1 1/4″-16 gauge.
Top [1]				
Face material thickness	5/16″	5/16″ [2]	1/2″ plywood	5/16″ [2].
Battens	4-1 1/8″×7/8″	2-1 3/8″×7/8″	None	2-1 3/8″×7/8″.

Wirebound boxes	Square box for preformed cushions	Octagonal box for preformed cushions	Cylindrical box for preformed cushions	Octagonal box for formed-in-place cushions
Base				
Face material thickness	9/16"	9/16" [2]	⅝" plywood	9/16" [2].
Battens	4-1⅛" × ⅞"	3-1⅜" × ⅞"	2-1⅛" × ⅞"	3-1⅜" × ⅞".
Runners	3⅝" × 9/16"	2-1⅞" × ⅞"	2-1⅝" × ⅞"	2-1⅞" × ⅞".

[1] A hole of suitable type may be made in top of box to provide for the protruding neck of inner container. There shall be 1 inch minimum clearance between bottle and inside of hole.

[2] One-half inch plywood face material authorized.

(1) Minimum construction requirements of 6½-gallon carboy shall be as follows:

Wirebound boxes	Dimensions
Faceboard thickness	¼".
Cleats	1 3/16" × ⅞".
Handle cleats	2⅛" × ⅞".
Binding wires:	
Number and gauge over outside cleats.	2-12 gauge.
Number and gauge intermediate wires.	2-13 gauge.
Staples	1¼"-16 gauge.
Base: Face material thickness	⅜" plywood.
Battens	1⅜" × ⅞".
Top (hood cover):	
Side faceboard thickness	¼".
Cleats	1 3/16" × ⅞".
Binding wires:	
Number and gauge over outside cleats.	2-13 gauge.
Top faceboard thickness	⅜" plywood.

(i) Outside container closure. When prepared for shipment, top hood cover must be positively secured to body of container.

(e) Assembly:

(1) The box shall be constructed to provide a snug fit with the cushioning for the inside container. Wooden shims of correct thickness may be used to keep carboy tight in overpack.

(2) The boxes shall be closed with threaded loop fasteners using a regular clinch.

[29 FR 18813, Dec. 29, 1964, as amended by Order 66, 30 FR 5748, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.14-7 Marking of outside container.

(a) On each container with letters and figures at least ¾ inch high applied by hot branding iron or colored ink with high pressure dies as follows:

(1) DOT-1K.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38180, Sept. 9, 1976]

§ 178.14-8 Tests.

(a) *Apparatus—Standard required.* Detailed prints may be obtained from the Associate Director for HMR.

(b) *Method.* Fill with water to lower edge of neck; swing 55 inches measured from wall to nearest bottom edge of basket:

(1) Test 10 carboys each against bottom and one side.

NOTE 1: Instances where 99 or less carboys are in service during either 6-month period of the year it shall be acceptable to test 10 percent of the total but not less than 3 carboys on both the side and bottom swing. If this provision is used, the report of test results must so state.

(c) *Acceptable results.* One hundred percent of carboys must not break under side or bottom shocks. If failures occur, the test is to be repeated with an additional 10 carboys for which the passing requirement shall be 100 percent.

(d) *When required.* By each manufacturer, at intervals not to exceed 6 months; separate tests required for:

(1) New packages.

(2) Used packages.

(3) Packages differing in kind or shape of cushioning.

(e) *Exception.* Tests not required by shipper who fills and ships or reships for one shipment only packages obtained from a manufacturer or shipper who has had tests made.

(f) *Reports.* Required to be made to the Associate Director for OE on form as follows:

REPORT OF TESTS OF CARBOYS

(As required by D.O.T. Regulations and Specifications)

(Place) ____________________
(Date) ____________________
Tests made for ____________________
(Give name and address of plant for which tests were made)

Description of package	Number of test	Results	
		55-inch swing	
		Side	Bottom
Capacity	1		
Condition [1]	2		
	3		
Type of inside container [2]	4		
	5		
Cushioning [3]	6		
	7		
Diameter of bottle	8		
	9		
Size of outside container	10		
(inside)	11		
	12		
Capacity	13		
Condition [1]	14		
	15		
Type of inside container [2]	16		
	17		
Cushioning [3]	18		
	19		
Diameter of bottle	20		
	21		
Size of outside container	22		
(inside)	23		
	24		

Specification mark is ....
Identification symbol is ....
Remarks ....
....
....
(Signature) ....
(Per) ....

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[1] State whether outside container is new or used.

[2] State whether glass, earthenware, etc.

[3] State whether hay, mineral wool, ground cork, excelsior, wood strips —— type, cork pads —— type, etc.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18813, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§ 178.15 [Reserved]

§ 178.16 Specification 35; non-reusable molded polyethylene drum for use without overpack; removable head required.

[Amdt. 178-42, 42 FR 36262, July 14, 1977]

§ 178.16-1 Compliance.

(a) Required in all details.

(b) Except as otherwise provided within this section, each drum must comply with the requirements of § 173.24 of this subchapter.

[Amdt. 178-42, 42 FR 36262, July 14, 1977]

§ 178.16-4 Material.

(a) Drums must be made of a prime, injection-molding grade of high density polyethylene having the following properties, as determined by the American Society for Testing and Materials (ASTM) methods designated and by tests performed on resin with additives included:

Property	Specification	ASTM method
Density range	0.941 to 0.965	D-1505-68
Tensile strength	3,000 lb/in.^{2}, minimum.	D-638-76
Percent elongation	75 pct minimum	D-638-76

Drums molded of such resin must comply with the performance testing requirements prescribed in § 178.16-13. The drum manufacturer shall retain data relating to the following material properties of each "as-received" lot of molding resin at the start of production:

MATERIAL PROPERTY

Density
Melt Index

The data must indicate the method used to obtain the numerical values and include all parameters (e.g., method of preparing test specimens; number of specimens tested; speed of testing; type of test specimens and dimensions, etc.) relative to test conditions. (ASTM methods may be cited where applicable.) Data on the above material properties shall be recorded and retained for each lot (i.e., quantity of material bearing the same manufacturer's lot identification number) of molding resin processed into drums. Records of the data, as well as a 100-gram sample of the resin, its lot identification number, and at least three drums molded from the resin, shall be retained for at least one year by each molder at each producing plant.

(b) Ultraviolet light protection may be provided by impregnation of polyethylene with carbon black or other equally efficient pigments or inhibitors. If used, these additives must be compatible with lading.

(c) Other materials may be added provided they do not adversely affect the physical properties specified in paragraph (a) of this section or the performance specified in § 178.16-13 and are compatible with the lading.

(d) Steel used in top head of drum must be low carbon of standard commercial quality.

[Amdt. 178-42, 42 FR 36262, July 14, 1977, as amended by Amdt. 178-47, 43 FR 29563, July 10, 1978]

§ 178.16-7 Construction and capacity.

(a) Rated capacity: Not to exceed 7 gallons. Minimum actual capacity shall not be less than rated capacity plus 4 percent. Maximum actual capacity shall not be greater than rated capacity plus 10 percent.

(b) Minimum thickness of drum measured at any point may not be less than 0.065-inch. If top head is constructed of steel, a minimum of 26-gauge steel must be used.

(c) The gross weight of each drum, when filled, may not exceed the maximum allowable gross weight indicated by the marking on the drum (see § 178.16-19).

[Amdt. 178-42, 42 FR 36262, July 14, 1977]

§ 178.16-10 Closure.

(a) Top head must be of the full removable type, and must be made of steel, polyethylene, or combination thereof. Steel top head must have no less than 16 lugs spaced no more than ¼-inch apart, or be attached to body by tin plate ring seal. Gaskets required when necessary to meet the performance tests prescribed in § 178.16-13.

(b) Openings in body of drum are not authorized.

[Amdt. 178-42, 42 FR 36262, July 14, 1977]

§ 178.16-13 Design qualification tests.

(a) The following tests must be performed at the start of production on each drum size and design. If any change is made to drum design, size, material used, or process, tests in this section must be repeated. Product leakage in any of the required tests will constitute a failure. No single drum will be expected to withstand more than one of the following tests:

(1) *Drop test.* Sample drums of each size and design, selected at random, must be filled to marked gross weight at normal outage with dry powder material and then topped with a minimum of one inch of sodium bicarbonate and closed as for use. Each test drum and contents must be conditioned to be at a temperature of 0° F. or below at the start of each drop test and must be observed immediately following each drop test for any evidence of leakage.

(i) Test drums must be dropped from a height of four feet onto solid concrete under the following conditions of orientation:

(A) Three drums must be dropped flat on bottom.

(B) Three drums must be dropped diagonally on top chime or edge.

(C) Three drums, oriented to impact on bail ear, must be dropped flat on side.

(ii) In event of failure, the individual orientation drop test causing the failure must be repeated with six additional drums. Failure of any of the six additional drums disqualifies that size or design from this specification until design qualification tests have been successfully repeated.

(2) *Vibration test.* Sample drums, three of each size and design, selected at random, must be filled and closed as for use as required in § 178.16-13(a)(1). The three fully loaded test drums must be placed on a platform that has a vertical double-amplitude (peak-to-peak displacement) of one inch. The drums should be constrained horizontally to prevent them from falling off the platform, but otherwise left free to move vertically, bounce and rotate. The test must be performed for one hour at a frequency that causes the drum to be raised from the vibrating platform to such a degree that a piece of material of approximately 1/16-inch thickness (such as steel strapping or paperboard) can be passed between the bottom of any drum and the platform. Immediately following the period of vibration, each drum must be removed from the platform, turned on its side and observed for any evidence of leakage. If failure (leakage) occurs,

the vibration test must be repeated on three additional drums without any leakage of contents. Failure of any one of the three additional drums disqualifies that size or design from this specification until design qualification tests have been successfully repeated.

(3) *Static compression test.* Two drums must be filled and closed as for use as required in § 178.16-13(a)(1) and conditioned so that drums and contents are at a temperature of 130° F. or higher at the start of each compression test. The two drums of identical capacity, stacked two high, must withstand a static compression test applied evenly for 48 hours to the top rim of the top drum without buckling of the side walls or leakage. The compression weight load to be applied must be the greater of 300 pounds or the volume in gallons of one drum times 85 pounds. Total top to bottom deflection of both drums may not exceed one inch. At the conclusion of the 48-hour test period, each drum must be turned on its side and observed for any evidence of leakage. If leakage occurs, or deflection exceeds the limits established above, the drum size or design is disqualified from this specification until design qualification tests have been successfully repeated.

(4) *Reports and records.* The manufacturer shall prepare a report on the tests prescribed in paragraphs (a) (1), (2), and (3) of this section and shall retain the report on the results of these tests for at least two years from date of tests. A copy of these reports must be retained by the manufacturer at each producing plant.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-42, 42 FR 36262, July 14, 1977, as amended by Amdt. 178-58, 44 FR 60102, Oct. 18, 1979]

§ 178.16-16 Periodic testing.

(a) At least one sample of each size and design of drum must be drop tested at each production plant from every 10,000 drums produced by each molding machine. As an alternative, the drop tests may be conducted once every 24 hours of uninterrupted production from each machine or at the resumption of production from a machine after shut down for one hour or more. No one drum will be expected to withstand more than one drop. Product leakage from drum in any of the following tests will constitute a failure. Tests must be as follows:

(1) One drum, filled and closed as for use as provided in § 178.16-13(a)(1), must be dropped onto solid concrete from a height of four feet diagonally on its top chime or edge.

(2) One drum, filled and closed as for use as provided in § 178.16-13(a)(1), must be dropped onto solid concrete from a height of four feet flat on its side. The drum must be oriented to impact on bail ear.

(b) Failure of drum when tested as described above disqualifies that size or design from this specification until design qualification tests (§ 178.16-13) have been repeated successfully.

[Amdt. 178-42, 42 FR 36262, July 14, 1977]

§ 178.16-19 Markings.

(a) The markings required by this section must be legible, in characters at least ¼-inch in height, and embossed on the bottom of each drum. The marking requirements of § 173.24 of this subchapter, with the exception of paragraph (c)(1)(ii), are applicable.

(b) The markings must be as follows:

(1) DOT-35-*; star to be replaced by maximum allowable gross weight in pounds (for example, DOT-35-50).

(2) "NRC" located near the DOT mark to indicate "non-reusable container."

(3) Month and year of manufacture, for example, DOT-35-20-2/74, to indicate the drum specification, maximum allowable gross weight, and that the drum was manufactured in February 1974.

(4) Registration number (M * * *) of the manufacturer.

(c) A packaging may not be marked with the specification identification "DOT-35" unless:

(1) It was manufactured in compliance with the requirements of this section, and

(2) Its manufacturer has a registration number (M * * *) from the Office of Hazardous Materials Operations, Materials Transportation Bureau, Department of Transportation, Washington, D.C. 20590.

[Amdt. 178-42, 42 FR 36262, July 14, 1977]

§ 178.17 Specification 1M; non-reusable glass carboy in non-reusable expanded polystyrene packaging.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 178-54, 44 FR 14198, Mar. 12, 1979]

§ 178.17-1 General requirements.

(a) Compliance is required in all details.

(b) Each glass carboy must fit snugly in its expanded polystyrene packaging.

(c) The glass carboy and expanded polystyrene packaging may not be used again after contents have been removed.

(d) A Specification 1D (§ 178.4 of this subchapter) glass carboy manufactured prior to January 1, 1979 may be used in place of the carboy described in this section, but the Specification 1D carboy must be previously unused and may not be subsequently reused after contents have been removed.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 178-54, 44 FR 14198, Mar. 12, 1979]

§ 178.17-2 Capacity.

Carboy may not exceed 6.5 United States gallons nominal capacity, 7.0 United States gallons overflow, tolerance plus or minus 10 fluid ounces.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 178-54, 44 FR 14198, Mar. 12, 1979]

§ 178.17-3 Construction requirements.

(a) Glass carboy:

(1) Each carboy must be machine blown with threads in the neck of the glass carboy for closing by a screw cap.

(2) Each carboy must be annealed and have a real temper not greater than 5.

(3) The weight of each carboy must be 14 pounds or greater with a tolerance of minus eight ounces.

(b) Expanded polystyrene packaging:

(1) Expandable polystyrene must be molded to form a protective outside packaging.

(2) This packaging must consist of a top and bottom section which interlock. Each section must be molded with a cavity to maintain a snug fit with the carboy.

(3) The density of the expanded polystyrene may be no less than 1.7 pounds per cubic foot, and no greater than 2.0 pounds per cubic foot.

(4) The minimum thickness of the expanded polystyrene must be 1 inch.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 178-54, 44 FR 14198, Mar. 12, 1979]

§ 178.17-4 Closure.

(a) Glass carboy:

(1) A gasketed or lined threaded screw cap is required. A vented closure must be provided when prescribed in Part 173 of this subchapter.

(b) Expanded polystyrene packaging:

(1) Except as provided in paragraph (b)(2) of this section, weather resistant, pressure sensitive cloth or other suitable tape must be circumferentially applies at the mating areas of the top and bottom section to prevent separation. The tape must be at least 2½ inches in width and have a tensile strength of not less than 50 pounds per inch of width. Tape must overlap both top and bottom sections circumferentially by not less than one inch. Tape ends must overlap a minimum of three inches.

(2) The two-section expanded polystyrene packaging may be closed for shipment by means of one or more vertical non-metallic straps of at least ½ inch in width and having a tensile strength of not less than 600 pounds.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 178-54, 44 FR 14198, Mar. 12, 1979]

§ 178.17-5 Tests.

(a) Glass carboy.

(1) *Annealing test.* After annealing, each glass carboy must have a real temper no greater than 5, when examined in accordance with the American Society for Testing and Materials publication ASTM C148-77, Method A. One carboy must be taken from each side row and one carboy from a center row of the annealing lehr at least every three hours during manufacture, and examined for temper number. If during polariscopic examination, it is determined that any carboy in a certain row has a real temper greater than 5, all carboys within that row must either be reject-

ed or re-annealed to comply with the prescribed test specification. Production back to the last approved examination must be quarantined, resampled and examined in accordance with the prescribed test procedure, after which production may be released if in conformance, or re-annealed to comply, or rejected.

(2) *Weight test.* Each day one carboy randomly selected from each mold must be weighed. If is fails to meet the weight requirement of § 178.17-3(a)(3), production back to last successful weight test from that mold must be quarantined and tested for weight or rejected. Non-conforming carboys must be rejected.

(3) *Hydrostatic pressure test.* One carboy must be taken from each mold at least every eight hours during manufacture and subjected to a minimum internal hydrostatic pressure of 40 p.s.i.g. instantaneous or 13 p.s.i.g. for one minute. If a carboy from any moldbreaks when subjected to the minimum internal pressure, four additional carboys from the same mold must be tested. If one or more of the four additional carboys breaks, all carboys from that mold produced since the last successful pressure test must be quarantined and tested for compliance or rejected.

(4) *Reports and records.* The manufacturer of the glass carboy or a person who performs these tests for the manufacturer must prepare a report on the test prescribed in paragraphs (a) (1), (2), and (3) of this section. The manufacturer of the glass carboy must retain the report on the results of each test for at least three years following the date of the test. These reports must be available for examination by representatives of the Department.

(b) Expanded polystyrene packaging:

(1) *Drop test.* Randomly selected samples of completed packages, with carboys filled with water to capacity and closed as for shipment, must be subjected to drop tests onto an unyielding surface. A minimum of six packages must be tested, each not required to be subjected to more than one drop. A complete test cycle consists of the following:

(i) Two units dropped flat on bottom from a height of four feet;

(ii) Two units dropped flat on side from a height of four feet; and,

(iii) Two units dropped flat on top from a height of four feet.

(2) *Results and testing frequency.* Each package in one test cycle must pass the test without leakage from or breakage of the glass carboy. If any package fails, the condition causing failure must be determined and corrected and additional testing conducted until a successful test cycle is obtained. Testing must be performed as follows:

(i) At the start of initial production from each mold, and upon any change in source of resin, type of resin, or process method. Tests must also be performed when any component or the design of the packaging is changed. Production may not commence until test requirements have been satisfied.

(ii) Periodically, at least every four months. If periodic testing indicates a packaging defect, packagings on hand produced subsequent to the last successful test date must be examined by appropriate means, and rejected if found defective. Users of the packagings must be advised of defects in packagings released prior to an unsuccessful test. Production may not commence until test requirements have been satisfied.

(3) *Records and testing responsibility.* The manufacturer of the expanded polystyrene packaging, or a person who performs these tests for the manufacturer, must conduct the testing prescribed in paragraphs (b)(1) and (b)(2) of this section and prepare a report on the test results. Reports must be retained by the manufacturer of the expanded polystyrene for three years from the date of test. Reports must be available for examination by representatives of the Department of Transportation.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 178-54, 44 FR 14198, Mar. 12, 1979]

§ 178.17-6 Markings.

(a) The marking required by this section must be legible and in characters at least one inch in height. Section 173.24(c)(1) (ii) and (iv) does not apply to the glass carboy and expanded polystyrene packaging. The marking provisions of § 172.312 apply.

(b) No person may mark any carboy or any expanded polystyrene packaging with the specification identification "DOT-1M" unless:

(1) The carboy or expanded polystyrene packaging is manufactured in compliance with this specification, and

(2) The manufacturer has a registration number (M****) from the Materials Transportation Bureau, Department of Transportation, Washington, D.C. 20590.

(c) Except for Specification 1D glass carboys marked in accordance with § 178.4-4, the following markings must be embossed on the bottom of each carboy:

(1) DOT-1M;

(2) NRC;

(3) Year of manufacture; and

(4) Registration number (M****) of the manufacturer.

(d) The following markings must be embossed on the bottom of each expanded polystyrene packaging;

(1) DOT-1M;

(2) NRC;

(3) Year of manufacture; and

(4) Registration number (M****) of the manufacturer.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 178-54, 44 FR 14199, Mar. 12, 1979]

§ 178.18 [Reserved]

§ 178.19 Specification 34; reusable molded polyethylene container for use without overpack. Removable head not authorized.

[Order 71, 31 FR 9073, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.19-1 Compliance.

(a) Required in all details.

[Order 71, 31 FR 9073, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.19-2 Material.

(a) Containers shall be made of polyethylene which shall have the following properties, as determined by the American Society for Testing Materials (ASTM) methods designated. Tests shall be performed on resin with additives included:

Property	Specification	ASTM method
Melt index	1.2 maximum	D 1238 (62T).
Density range	0.941–0.965	D 1505 (63T).
Tensile strength	3,000 p.s.i. minimum.	D 638 (61T).
Percent elongation	75 percent minimum.	D 638 (61T).

(b) Ultraviolet light protection shall be provided by impregnation of polyethylene with carbon black or other equally efficient pigments or inhibitors. These additives must be compatible with lading and must retain their effectiveness for the life of the container.

(c) Other materials may be added provided they do not adversely affect the physical properties specified in paragraph (a) of this section or the performance specified in § 178.19-7.

[Order 71, 31 FR 9073, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.19-3 Construction and capacity.

(a) Container must be constructed in accordance with the following table:

Marked (rated) capacity not over (gallons) [1]	Minimum thickness (inches) measured on any point of container
2½ thru 6½	0.045
15	.075
30	.125

[1] Minimum actual capacity shall not be less than rated capacity plus 4 percent. Maximum actual capacity shall not be greater than rated capacity plus 15 percent for containers up to 15 gallons and shall not be greater than rated capacity plus 10 percent for containers 15 gallons and over.

[Order 71, 31 FR 9073, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.19-4 Closure.

(a) Openings shall not exceed 2.7 inches in diameter.

(b) Closures shall be of material resistant to lading and adequate to prevent leakage under tests prescribed in § 178.19-7 and under conditions incident to transportation.

(c) Vented closures where specified in Part 173 of this chapter are authorized.

[Order 71, 31 FR 9073, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.19-5 Defective containers.

(a) Containers with repaired bodies not authorized.

[Order 71, 31 FR 9073, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.19-6 Marking.

(a) Each container must be permanently marked by embossment in letters and figures at least ½ inch in size as follows:

(1) DOT-34**; stars to be replaced by the rated capacity of the container (for example, DOT-34-5).

(2) Month and year of manufacture. For example, DOT-34-5-6/65 to indicate a container of 5 gallons capacity made in June 1965.

(3) Name or symbol of person making the marks specified in paragraphs (a)(1) and (a)(2) of this section and located just above or below those marks. Symbol, if used, must be registered with the Associate Director for OE.

[Amdt. 178-40, 41 FR 38180, Sept. 9, 1976]

§ 178.19-7 Tests.

(a) At least three samples taken at random, filled and prepared as specified and closed as for use, shall be capable of withstanding the tests in paragraphs (a) (1), (2), and (3) of this section without leakage. These tests shall be performed at the start of initial production and at 4-month intervals and shall be repeated on any change of type, size, materials, or process method. No single container shall be expected to withstand more than one of the following tests:

(1) The container filled to 98 percent capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge or any part constructed to a lesser strength.

(2) The container filled to 98 percent capacity with a solution compatible with polyethylene and which remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F. Filled container shall be stored at 0° F. or lower temperature for at least 4 hours immediately preceding test.

(3) The container shall be tested by retaining for 5 minutes hydrostatic pressure of at least 15 pounds per square inch at equilibrium without showing pressure drop or evidence of leakage.

(b) At least three containers taken at random from each continuous production lot of no more than 1,000 containers of each given type and size shall withstand without leakage or failure the test prescribed in § 178.19-7(a)(2).

(c) At least three containers of each size and type taken at random at start of initial production, and upon any change in materials, design, or process method shall withstand without failure or leakage the following tests. No single container shall be expected to withstand more than one test:

(1) The container filled to 98 percent of capacity with water shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for one hour using an amplitude of one inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

(2) The container filled to 98 percent capacity with water shall withstand the following static compression test without buckling of the side walls sufficient to cause damage, but in no case shall the maximum top to bottom deflection be more than one inch. Compression shall be applied to the load bearing areas of the top of the container for a period of not less than 48 hours.

Marked (rated) capacity (gallons)	Compression test (pounds)
2½ thru 6½	600
15	1,200
30	1,800

(d) Records of test results to be maintained in current status and retained by each manufacturer at each producing plant.

[Order 71, 31 FR 9073, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

Subpart B—Specifications for Inside Containers, and Linings

SOURCE: 29 FR 18823, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§ 178.21 Specification 2T; polyethylene container.

§ 178.21-1 Compliance.

(a) Required in all details.

§ 178.21-2 Capacity and marking of container.

(a) Containers of 5 to 13 gallons capacity are covered by this specification. Actual capacity of the container must be the marked capacity plus 5 percent minimum.

(b) Each container must be permanently marked with figures and letters at least ¼ inch high to show:

(1) DOT-2T.

(2) Name or symbol of person making the mark specified in paragraph (b)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Month and year of manufacture.

[Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.21-3 Material.

(a) Containers shall be made of polyethylene and shall have the following properties (see Note 1):

Melt index	2.6 maximum.
Density	0.910-0.925.
Tensile strength	1500 pounds per square inch minimum.
Percent elongation	400 percent minimum.

NOTE 1: Other materials may be added if they do not affect the properties specified in paragraph (a) of this section.

(1) Container must have a minimum weight and wall thickness in accordance with the following table:

Marked capacity not over (gallons)	Minimum wall thickness (inch)	Minimum weight of containers (pounds)
5	0.0625	3
6½	.0625	4
13	.0625	8

(b) Closing device shall be of material resistant to the lading and adequate to prevent leakage and not over 3½ inches in diameter.

(c) Tests. Samples taken at random, empty or filled, and prepared as specified and closed as for use, shall be capable of withstanding the following tests without breakage or leakage:

(1) Empty container shall be dropped on any part from a height of 6 feet onto solid concrete, immediately after conditioning for at least 24 hours at 0° F. —

(2) The polyethylene container in a prescribed outer specification container, as authorized by Part 173 of this chapter, filled to 98 percent of capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge of any part considered weaker.

(3) The polyethylene container in a prescribed outer specification container, as authorized in Part 173 of this chapter, filled to 98 percent of capacity with a solution which is compatible with polyethylene and remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F.

(4) The polyethylene container in a prescribed outer specification container as authorized in Part 173 of this chapter, filled to 98 percent of capacity with water shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed.

The test shall be performed for 1 hour using an amplitude of 1 inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

(d) Polyethylene container must fit snugly in outside container.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18823, Dec. 29, 1964, as amended by Order 66, 30 FR 5748, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and further amended by Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§ 178.22 Specification 2C; inside containers, corrugated fiberboard cartons.

§ 178.22-1 Construction.

(a) To be of double-wall board, 275-pound strength, or 2 thicknesses of double-faced board, 175-pound strength. Mullen or Cady test; slides or linings to be 1-piece with joint cloth-taped.

§ 178.22-2 Outside container.

(a) Outside container must be lined throughout with, and cartons separated by, double-wall corrugated fiberboard of 275-pound strength, Mullen or Cady test.

§ 178.23 Specification 2D; inside containers, duplex paper bags.

§ 178.23-1 Construction.

(a) Bags to be at least 2 thicknesses of shipping sack Kraft paper, or equivalent, and as follows:

Maximum weight of contents (pounds)	Minimum[1] weight (per 500 sheets 24"×36")	
	One sheet, weight[1] (pounds)	One sheet, weight[1] (pounds)
2	30	30
6	50	40
12	60	50
25	70	60

[1] Weight 15 percent less authorized for rope paper containing 35 percent or more of manila rope fiber.

[29 FR 18823, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-25, 36 FR 18469, Sept. 15, 1971]

§ 178.23-2 Test.

(a) Bags, filled and closed as for shipment, must be able to withstand drop of 4 feet onto concrete without rupture or sifting, except that 2-foot drop is acceptable for bags to contain 25 pounds.

§ 178.24 Specification 2U; molded or thermoformed polyethylene containers having rated capacity of over one gallon. Removable head containers or containers fabricated from film not authorized.

§ 178.24-1 Compliance.

(a) Required in all details.

§ 178.24-2 Material.

(a) Containers shall be made of polyethylene and shall have the following properties (see Note 1):

Melt index	2.6 maximum.
Density	0.910–0.925.
Tensile strength	1500 pounds per square inch minimum.
Percent elongation	400 percent minimum.

NOTE 1: Other materials may be added if they do not affect the properties specified in paragraph (a) of this section.

NOTE 2: Type III polyethylene, as specified in Appendix B to this part, is authorized for containers up to 6 gallons marked capacity (6½ gallons maximum capacity).

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18823, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-15, 35 FR 18528, Dec. 5, 1970; Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§ 178.24-3 Construction capacity.

(a) Container must be constructed in accordance with the following table:

Rated capacity not over (gallons)	Minimum overall thickness (inch)[1]	Percent outage over marked capacity permitted
5	0.010	15
15	.015	15
55	.015	5

[1] For cubical containers, the area adjacent to and forming the opening for closure may have a minimum thickness of 0.008 inch for 5 gallons rated capacity and sizes larger than 5 gallons may have a minimum thickness of 0.010 inch.

(b) Polyethylene container must fit snugly in outside container.

[29 FR 18823, Dec. 29, 1964, as amended by Order 66, 30 FR 5749, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.24-4 Closure.

(a) Shall be of material resistant to lading and adequate to prevent leakage. Vented closures where specified under Part 173 of this chapter authorized. No opening over 2.7 inches in diameter authorized.

§ 178.24-5 Marking.

(a) Each container must be permanently marked by embossment in figures and letters at least ¼ inch in size to show:

(1) DOT-2U.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Month and year of manufacture.

(4) Rated capacity.

[Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.24-7 Tests.

(a) Samples taken at random shall withstand prescribed tests without breakage or leakage. Tests shall be made on each type and size at each manufacturing location starting production and shall be repeated every four months. The type tests are as follows:

(1) The polyethylene container in a prescribed outer specification container, as authorized by Part 173 of this chapter, filled to 98 percent of capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge or any part considered weaker.

(2) The polyethylene container in a prescribed outer specification container, as authorized by Part 173 of this chapter, filled to 98 percent of capacity with a solution which is compatible with polyethylene and remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F.

(3) The polyethylene container in a prescribed outer specification container, as authorized in Part 173 of this chapter, filled to 98 percent of capacity with water shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for one hour using an amplitude of one inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tap can be passed between the table and the container.

[29 FR 18823, Dec. 29, 1964, as amended by Order 66, 30 FR 5749, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.24a Specification 2E; inside polyethylene bottle.

[Amdt. 178-11, 35 FR 11473, July 17, 1970]

§ 178.24a-1 General requirements.

(a) Each bottle must meet the applicable requirements of § 173.24 of this chapter.

[Amdt. 178-5, 34 FR 12593, Aug. 1, 1969]

§ 178.24a-2 Rated capacity.

(a) Maximum capacity not to exceed 5 quarts.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1 and paragraph (a)(4) App. A to Part 106)

[Amdt. 178-61, 45 FR 46423, July 10, 1980]

§ 178.24a-3 Materials of construction.

(a) Each bottle must be made of a blow-molding grade of polyethylene, constructed so that it will maintain its shape when standing empty and open.

(b) Wall thickness must not be less than 0.008 inch (0.2 millimeters).

(c) Polyethylene must have properties as specified in Table I of Appendix B to this part.

[Amdt. 178-5, 34 FR 12593, Aug. 1, 1969]

§ 178.24a-4 Closure.

(a) Closing devices must provide a tight seal. Vented closures are not authorized unless otherwise provided for in Part 173 of this chapter.

[Amdt. 178-5, 34 FR 12593, Aug. 1, 1969]

§ 178.24a-5 Tests.

(a) Each bottle must be capable of withstanding the prescribed tests without breaking or leaking.

(b) The test prescribed in paragraph (d)(1) of this section must be made on at least three random sample bottles for each 1,000 bottles produced by each blow-molding machine. The test must be performed at the start of initial production from each blow-molding machine and upon any change in type of polyethylene or process method.

(c) The test prescribed in paragraph (d)(2) of this section must be made at least once each month on a minimum of three random sample bottles produced and upon any change in type of polyethylene or process method.

(d) Prescribed tests:

(1) The bottle, filled to 98 percent of capacity with water, must be dropped from a height of 4 feet onto a solid unyielding surface so as to drop diagonally on the top edge or any other part which is weaker.

(2) The bottle, filled to 98 percent of capacity with a liquid which is compatible with polyethylene and which is liquid at 0° F., must be dropped from a height of 4 feet onto a solid unyielding surface, on any part of the bottle. Immediately prior to the test, the bottle and its contents must have been at a temperature of 0° F. or lower for at least 24 hours.

[Amdt. 178-5, 34 FR 12593, Aug. 1, 1969]

§ 178.24a-6 Marking.

(a) Marking must be as prescribed in § 173.24 of this subchapter, except as follows:

(1) Marking must be by embossment in at least 1/16 inch figures for bottles of one quarter or less capacity and at least ⅛ inch figures for bottles of more than one quart capacity as follows: "DOT-2E", the minimum thickness of the polyethylene in thousandths of inches (mils), and the year of manufacture (e.g., DOT-2E 15-69).

[Amdt. 178-5, 34 FR 12593, Aug. 1, 1969, as amended by Amdt. 178-11, 35 FR 11473, July 17, 1970; Amdt. 178-40, 41 FR 38180, Sept. 9, 1976; 41 FR 42206, Sept. 27, 1976]

§ 178.25 Specification 2F; inside metal containers and liners.

§ 178.25-1 Construction.

(a) Containers over 1-gallon capacity and all lining must be at least 30 gauge, United States standard (commercial 107-pound tin plate) and sealed leakproof.

§ 178.26 Specification 2G; inside containers, fiber cans and boxes.

§ 178.26-1 Capacity, and thickness of metal and fiber.

(a) Capacity not over 6 pounds, net Metal tops, bottoms, and connections of suitable thickness are authorized. Minimum fiber thickness as follows:

(1) Up to ¼-pound size: 0.021".

(2) Up to 1-pound size: 0.026".

(3) Up to 3-pound size: 0.036".

(4) Up to 6-pound size: 0.050", provided that 0.036" fiber heads with 130-pound strength[1] are authorized; or 0.028" with 175-pound strength;[1] or 0.036" with 90-pound strength,[1] provided each container is wrapped with shipping sack Kraft paper of 60-pound base weight pasted thereon.

§ 178.27 Specification 2TL; polyethylene container.

§ 178.27-1 Material requirements.

(a) Containers shall be made of polyethylene and shall have the following properties (see Note 1):

Melt index	2.6 maximum.
Density	0.910–0.925.
Tensile strength	1500 pounds per square inch minimum.
Percent elongation	400 percent minimum.

NOTE 1: Other materials may be added if they do not affect the properties specified in paragraph (a) of this section.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18823, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

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[1] Mullen or Cady test.

§ 178.27-2 Construction, capacity and marking.

(a) Container must be constructed in accordance with the following table:

Marked capacity[1] not over (gallons)	Minimum wall thickness (inches)	Minimum weight of containers (pounds)
5	0.015	1
14	.050	5⅓

[1] Actual capacity must be the marked capacity plus 5 percent minimum.

(b) Closure: Closure shall be of material resistant to lading and adequate to prevent leakage. Vented closures where specified under Part 173 of this chapter authorized. No opening over 3½ inches in diameter authorized.

(c) Marking: Each container must be permanently marked in figures and letters at least ¼ inch in size to show:

(1) DOT-2TL.

(2) Name or symbol of person making the mark specified in paragraph (c)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Month and year of manufacture.

(4) Rated (marked) capacity.

(d) Polyethylene container must fit snugly in outside container.

[29 FR 18823, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.27-3 Type test.

(a) Samples taken at random shall withstand prescribed test without breakage. Test shall be made on each type and size at each manufacturing location starting production and shall be repeated every four months. The type test is as follows:

(1) Empty container shall be dropped on any part from a height of 6 feet onto solid concrete, immediately after conditioning for at least 24 hours at 0° F.

§ 178.27-4 Tests.

(a) Samples taken at random, filled and prepared as specified and closed as for use, shall be capable of withstanding the following tests without leakage:

(1) The polyethylene container in a prescribed outer specification container as authorized by Part 173 of this chapter, filled to 98 percent capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge or on any part considered weaker.

(2) The polyethylene container in a prescribed outer specification container, as authorized by Part 173 of this chapter, filled to 98 percent capacity with a solution which is compatible with polyethylene and remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F.

(3) The polyethylene container in a prescribed outer specification container, as authorized in Part 173 of this chapter, filled to 98 percent of capacity with water shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for 1 hour using an amplitude of 1 inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

[29 FR 18823, Dec. 29, 1964, as amended by Order 66, 30 FR 5749, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.28 Specification 2J; inside containers, waterproof paper bags for linings.

§ 178.28-1 Material.

(a) Two sheets of paper cemented together and creped to afford 25 percent stretch; paper to be shipping sack Kraft 30 pounds per ream (500 sheets, 24" × 36") before creping; total weight 90 pounds per ream.

§ 178.28-2 Test.

(a) Material folded into cones and filled with water to depth of 2" at 70° F. must not show water on outside within 24 hours.

§ 178.28-3 Construction.

(a) Form to fit the outside container without stretching; seams and closures to afford a siftproof bag.

§ 178.29 Specification 2K; inside containers, paper bags for linings.

§ 178.29-1 Paper and construction.

(a) Shipping sack Kraft paper, creped; at least 45 pounds per ream (500 sheets, 24″ × 36″) before creping.

(b) *Construction.* Form to fit the outside container without stretching; seams and closure to afford a siftproof bag.

§ 178.30 Specification 2L; lining for boxes.

§ 178.30-1 Box lining.

(a) Box lining must be of strong paraffined paper, or other suitable material, without joints or other openings at the bottom or at sides of box, and shall fully protect contents in contact with top of box.

(b) Tensile strength of material must be at least 35 pounds with the grain and 17 pounds across grain, tested by direct pull on strips measuring 3″×1″. Average results of three or more tests with the grain and three or more across grain shall be used.

(c) Material shall be impervious to water and nitroglycerin at 77° F. Test for imperviousness shall consist of folding material into cones, loosely to avoid breakage at creases. Cones tested for nitroglycerin shall be filled to 1″ depth; those for water to 2″. No leakage of liquid shall occur during 24 hours' exposure.

(d) Material must transmit no oily or greasy stain to unglazed paper. Test shall consist of placing one thickness of material, with two thicknesses of unglazed paper on each side, in an oven at 104° F. for 24 hours, under pressure of a lead disk 1½″ thick and of 10 pounds weight resting edgewise on the paper.

(e) Saturating paraffin, when used, shall have melting point of 125° F. or above. Test shall consist of extracting paraffin from 1 ounce or more of material with ether. After evaporation of all ether, paraffin shall be melted and poured upon the surface of water contained in a hemispherical dish approximately 3¾″ in diameter. Dish shall be three-fourths full of water above melting point of paraffin. Thermometer shall be placed with bulb three-fourths immersed in center of dish. Water and paraffin shall be allowed to cool until paraffin upon the surface of water commences to solidify. Temperature shall then be read and recorded as melting point of paraffin.

§ 178.30-2 Bag.

(a) Bag complying with requirements of paragraphs (b), (c), and (d) of this section also authorized.

(b) Material must be: 2 sheets of shipping sack Kraft paper joined by asphaltum, or equivalent; outer sheet at least 60 pounds and inner sheet at least 30 pounds per ream (500 sheets, 24″ × 36″); inner sheet coated with wax, or equivalent, with melting point at least 125° F.; compliance with § 178.30-1 (b) and (c) required.

(c) Seams must be pasted with adhesive not affected by nitroglycerin.

(d) Completed bag must be formed to fit outside container without undue strain and must be impervious to seepage of nitroglycerin.

§ 178.31 Specification 2M; waterproofed paper lining.

§ 178.31-1 Waterproofed paper.

(a) Waterproofed paper for box lining must be strong, folded or constructed without joints or openings at sides, bottoms, or ends, and shall fully protect contents at top of box.

§ 178.32 Specification 2N; inside containers, metal cans.

§ 178.32-1 Size.

(a) Not over 14-pounds water capacity (388 cubic inches).

§ 178.32-2 Material.

Each can must be made of good quality tin plate with parts and dimensions in compliance with the requirements of the following table:

Maximum diameter of can (inches)	Minimum thickness of metal (inch)	
	In body	In heads
$4\frac{5}{16}$	0.01134 (107 lb tin plate).	0.01305 (128 lb tin plate).[1]
$6\frac{11}{16}$	0.01134 (107 lb tin plate).	0.01485 (148 lb tin plate).[2]
$6\frac{11}{16}$	0.01405 (135 lb tin plate).	0.01405 (135 lb tin plate).[3]

[1] The minimum thickness of metal in each head may be 107 lb tin plate provided side seams are soldered and heads are attached to body sections by full double seams internally soldered.

[2] The minimum thickness of metal in each head may be 135 lb tin plate provided side seams are soldered and heads are attached to body sections by full double seams internally soldered.

[3] Top heads must be attached to body sections by full double seams with durable seaming compound, and bottom heads must be attached to body sections by soldering.

[Amdt. 178-32, 39 FR 12752, Apr. 8, 1974]

§ 178.32-3 Manufacture.

(a) Seams soldered or full double seam. Outside surface rustproofed by lacquer or equivalent.

§ 178.32-4 Test.

(a) When closed as for shipment, must be capable of standing 40-pound interior pressure without leakage.

§ 178.33 Specification 2P; inside nonrefillable metal containers.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33-1 Compliance.

(a) Required in all details.

§ 178.33-2 Type and size.

(a) Single-trip inside containers. Must be seamless, or with seams, welded, soldered, brazed, double seamed, or swedged.

(b) The maximum capacity of containers in this class shall not exceed 50 cubic inches (27.7 fluid ounces). The maximum inside diameter shall not exceed 3 inches.

[29 FR 18813, Dec. 29, 1964, as amended by Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33-3 Inspection.

(a) By competent inspector.

§ 178.33-4 Duties of inspector.

(a) To inspect material and completed containers and witness tests, and to reject defective materials or containers.

§ 178.33-5 Material.

(a) Uniform quality steel plate such as black plate, electro-tin plate, hot dipped tin plate, tern plate or other commercially accepted can making plate; or nonferrous metal of uniform drawing quality.

(b) Material with seams, cracks, laminations or other injurious defects not authorized.

§ 178.33-6 Manufacture.

(a) By appliances and methods that will assure uniformity of completed containers; dirt and scale to be removed as necessary; no defect acceptable that is likely to weaken the finished container appreciably; reasonably smooth and uniform surface finish required.

(b) Seams when used must be as follows:

(1) Circumferential seams: By welding, swedging, brazing, soldering, or double seaming.

(2) Side seams: By welding, brazing, or soldering.

(c) Ends: The ends shall be of pressure design.

[29 FR 18823, Dec. 29, 1964, as amended by Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33-7 Wall thickness.

(a) The minimum wall thickness for any container shall be 0.007 inch.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33-8 Tests.

(a) One out of each lot of 25,000 containers or less, successively produced per day shall be pressure tested to destruction and must not burst below 240 pounds per square inch gauge pressure. The container tested shall be complete with end assembled.

(b) Each such 25,000 containers or less, successively produced per day, shall constitute a lot and if the test container shall fail, the lot shall be rejected or ten additional containers may be selected at random and subjected to the test under which failure occurred. These containers shall be complete with ends assembled. Should any of the ten containers thus tested fail, the entire lot must be rejected. All containers constituting a lot shall be of like material, size, design construction, finish, and quality.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33-9 Marking.

(a) By means of printing, lithographing, embossing, or stamping, each container must be marked to show:

(1) DOT-2P.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

[Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.33a Specification 2Q, inside nonrefillable metal containers.

[Amdt. 178-43, 42 FR 42208, Aug. 22, 1977]

§ 178.33a-1 Compliance.

(a) Required in all details.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33a-2 Type and size.

(a) Single-trip inside containers. Must be seamless, or with seams welded, soldered, brazed, double seamed, or swedged.

(b) The maximum capacity of containers in this class shall not exceed 55 *cubic* inches (30.5 fluid ounces). The maximum inside diameter shall not exceed 3 inches.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-43, 42 FR 42208, Aug. 22, 1977]

§ 178.33a-3 Inspection.

(a) By competent inspector.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33a-4 Duties of inspector.

(a) To inspect material and completed containers and witness tests, and to reject defective materials or containers.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33a-5 Material.

(a) Uniform quality steel plate such as black plate, electrotin plate, hot dipped tinplate, ternplate or other commercially accepted can making plate; or nonferrous metal of uniform drawing quality.

(b) Material with seams, cracks, laminations or other injurious defects not authorized.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33a-6 Manufacture.

(a) By appliances and methods that will assure uniformity of completed containers; dirt and scale to be removed as necessary; no defect acceptable that is likely to weaken the finished container appreciably; reasonably smooth and uniform surface finish required.

(b) Seams when used must be as follows:

(1) Circumferential seams. By welding, swedging, brazing, soldering, or double seaming.

(2) Side seams. By welding, brazing or soldering.

(c) Ends. The ends shall be of pressure design.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33a-7 Wall thickness.

(a) The minimum wall thickness for any container shall be 0.008 inch.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33a-8 Tests.

(a) One out of each lot of 25,000 containers or less, successively produced per day, shall be pressure tested to destruction and must not burst below 270 pounds per square inch gauge pressure. The container tested shall be complete with end assembled.

(b) Each such 25,000 containers or less, successively produced per day, shall constitute a lot and if the test container shall fail, the lot shall be rejected or ten additional containers may be selected at random and subjected to the test under which failure occurred. These containers shall be complete with ends assembled. Should any of the ten containers thus tested fail, the entire lot must be rejected. All containers constituting a lot shall be of like material, size, design, construction, finish and quality.

[Order 71, 31 FR 9074, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.33a-9 Marking.

(a) By means of printing, lithographing, embossing, or stamping, each container must be marked to show:

(1) DOT-2Q.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

[Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.34 Specification 2R; inside containment vessel.

[Amdt. 178-35, 39 FR 45245, Dec. 31, 1974]

§ 178.34-1 General requirements.

(a) Each vessel must be made of stainless steel, malleable iron, or brass, or other material having equivalent physical strength and fire resistance.

(b) Each vessel must meet all of the applicable requirements of § 173.24 (c) and (d) of this subchapter. Letters and numerals at least 6 millimeters (¼-inch) in height are authorized for the marking of a vessel not exceeding 5 centimeters (2 inches) inside diameter.

[Amdt. 178-35, 39 FR 45245, Dec. 31, 1974]

§ 178.34-2 Manufacture.

The ends of the vessel must be fitted with screw-type closures or flanges (see § 178.34-4), except that one or both ends of the vessel may be permanently closed by a welded or brazed plate. Welded or brazed side seams are authorized.

[Amdt. 178-35, 39 FR 45245, Dec. 31, 1974]

§ 178.34-3 Dimensions.

(a) The inside diameter of the vessel may not exceed 30 centimeters (12 inches) exclusive of flanges for handling or fastening devices and must have wall thickness and length in accordance with the following:

Inside diameter maximum		Threaded closure		Wall thickness minimum—Flanged closure	Length maximum	
Inches	Centimeters	Inches	Millimeters		Inches	Centimeters
2	5	3/32	2.5	Not less than that prescribed for schedule 40 pipe	16	41
6	15	1/8	3.2		72	183
12	30	1/4	6.5		72	183

[Amdt. 178-35, 39 FR 45245, Dec. 31, 1974]

§ 178.34-4 Closure devices.

(a) Each closure device must be as follows:

(1) Screw-type cap or plug; number of threads per inch must not be less than United States standard pipe threads and must have sufficient length of thread to engage at least 5 threads when securely tightened. Pipe threads must be luted with an appropriate non-hardening compound which must be capable of withstanding up to 149° C. (300° F) without loss of efficiency. Tightening torque must be adequate to maintain leak tightness with the specific luting compound.

(2) An opening may be closed by a securely bolted flange and leak-tight gasket. Each flange must be welded or brazed to the body of the 2R vessel per (ANSI) Standard B16.5 or (AWWA) Standard C207-55, section 10. A torque wrench must be used in securing the flange with a corresponding torque of no more than twice the force necessary to seal the selected gasket. Gasket material must be capable of withstanding up to 149° C (300° F) without loss of efficiency. The flange, whether of ferrous or nonferrous metal, must be constructed from the same metal as the vessel and must meet the dimensional and fabrication

specifications for welded construction as follows:

(i) Pipe flanges described in Tables 13, 14, 16, 17, 19, 20, 22, 23, 25 and 26 of ANSI B16.5.

(ii) For nominal pipe sizes, 6, 8, 10, and 12 inches, AWWA Standard C207-55, Table 1, class B, may be used in place of the tables prescribed by paragraph (a)(2)(i) of this section.

(iii) Sizes under 6 inches, nominal pipe size, the following table with the same configuration as illustrated in AWWA C207-55, Table 1, class B, may be used in place of paragraph (a)(2)(i) of this section.

Nominal pipe size		Flange O.D.		Number of bolts	Bolt circle diameter		Diameter of bolts		Flange thickness	
Inches	Centimeters	Inches	Centimeters		Inches	Centimeters	Inches	Centimeters	Inches	Centimeters
2	5	6	15	4	4¾	11.8	½	1.2	⅝	1.6
2½	6.2	7	17.5	4	5½	13.8	½		⅝	
3	7.5	7½	18.8	4	6	15	½		⅝	
3½	8.8	8½	21.3	8	7	17.5	½		⅝	
4	10	9	22.5	8	7½	18.8	½		⅝	
5	12.6	10	25.4	8	8½	21.3	½		⅝	

(iv) Cast iron flanges prohibited.

[Amdt. 178-35, 39 FR 45245, Dec. 31, 1974; 40 FR 2435, Jan. 13, 1975, as amended at 40 FR 44327, Sept. 26, 1975]

§ 178.35 Specification 2S; polyethylene packaging.

Removable head container not authorized.

[29 FR 18823, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-48, 43 FR 31143, July 20, 1978]

§ 178.35-1 Compliance.

(a) Required in all details.

§ 178.35-2 Material requirements.

Packaging must be made of type I polyethylene as described in Appendix B to this part except the melt index may be 2.6 maximum. Other materials may be added to the polyethlene resin provided they do not affect adversely the properties specified for the type in Appendix B. When required by Part 173 of this subchapter, packaging must be made of type II or III polyethylene as specified.

[Amdt. 178-48, 43 FR 31143, July 20, 1978]

§ 178.35-3 Construction, capacity and marking.

(a) Container must be constructed in accordance with the following table:

Marked capacity not over (gallons)[1]	Maximum capacity (gallons)	Minimum thickness—side wall and heads (inches)[2]	Minimum weight (pounds)
5	6	0.0625	1.4
13.5	14.5	.0625	3.25
15	16	.0625	3.5
30	32	.0625	5.5
55	58	.0625	9

[1] Marked capacity shall be minimum capacity.

[2] Side openings are not authorized.

(b) Marking: Each container must be permanently marked with figures and letters at least ¼ inch in size to show:

(1) DOT-2S.

(2) Name or symbol of person making the mark specified in paragraph (b)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Month and year of manufacture.

(4) Minimum capacity.

(c) Polyethylene container must fit snugly in outside container.

[29 FR 18823, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, as amended by Amdt. 178-15, 35 FR 18528, Dec. 5, 1970; Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.35-4 Closures.

(a) Closing devices must be of screw thread type or fastened by positive means and be of material resistant to the lading and adequate to prevent leakage.

(b) Openings over 2.3 inches in diameter not permitted.

§ 178.35-5 Tests.

(a) Samples taken at random, empty or filled, and prepared as specified and closed as for use, shall be capable of withstanding the following tests without breakage or leakage:

(1) Empty container shall be dropped on any part from a height of 6 feet onto solid concrete, immediately after conditioning for at least 24 hours at 0° F.

(2) The polyethylene container in a prescribed outer specification container, as authorized by Part 173 of this chapter, filled to 98 percent of capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge or any part considered weaker.

(3) The polyethylene container in a prescribed outer specification container, as authorized by Part 173 of this chapter, filled to 98 percent of capacity with a solution which is compatible with polyethylene and remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F.

(4) The polyethylene container in a prescribed outer specification container, as authorized in Part 173 of this chapter, filled to 98 percent of capacity with water shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for 1 hour using an amplitude of 1 inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

[29 FR 18823, Dec. 29, 1964, as amended by Order 66, 30 FR 5749, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.35a Specification 2SL; molded or thermoformed polyethylene packaging.

Removable head container or container fabricated from film not authorized.

[29 FR 18823, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-48, 43 FR 31143, July 20, 1978]

§ 178.35a-1 Material requirements.

Packaging must be made of type I polyethylene as described in Appendix B to this part except the melt index may be 2.6 maximum. Other materials may be added to the polyethylene resin provided they do not affect adversely the properties specified for the type in Appendix B. When required by part 173 of this subchapter, packaging must be made of type II or III polyethylene as specified.

[Amdt. 178-48, 43 FR 31143, July 20, 1978]

§ 178.35a-2 Construction, capacity and marking.

(a) Container must be constructed in accordance with the following table:

Marked capacity—not over (gallons) [1]	Maximum capacity (gallons)	Minimum thickness—side wall and heads (inches) [2]	Minimum weight (pounds)
13.5	14.5	0.030	2
15	16	.030	2.25
30	32	.030	3.25
55	58	.040	5

[1] Marked (actual) capacity shall be minimum capacity.
[2] Side openings are not authorized.

(b) Closure: Closure shall be of material resistant to lading and adequate to prevent leakage. Vented closures where specified under Part 173 of this chapter are authorized. No opening over 2.3 inches in diameter authorized.

(c) Markings: Each container must be permanently marked with figures and letters at least ¼ inch in size to show:

(1) DOT-2SL.

(2) Name or symbol of person making the mark specified in paragraph (c)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Month and year of manufacture.

(4) Minimum capacity.

(d) Polyethylene container must fit snugly in outside container.

[29 FR 18823, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-15, 35 FR 18528, Dec. 5, 1970; Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.35a-3 Type test.

(a) Samples taken at random shall withstand prescribed test without breakage. Test shall be made on each type and size at each manufacturing location starting production and shall be repeated every four months. The type test is as follows:

(1) Empty container shall be dropped on any part from a height of 6 feet onto solid concrete immediately after conditioning for at least 24 hours at 0° F.

§ 178.35a-4 Tests.

(a) Samples taken at random, filled and prepared as specified and closed as for use, shall be capable of withstanding the following tests without leakage:

(1) The polyethylene container in a prescribed outer specification container, as authorized by Part 173 of this chapter, filled to 98 percent of capacity with water shall be dropped from a height of 4 feet onto solid concrete so as to drop diagonally on top edge or any part considered weaker.

(2) The polyethylene container in a prescribed outer specification container, as authorized by Part 173 of this chapter, filled to 98 percent of capacity with a solution which is compatible with polyethylene and remains liquid at 0° F. shall be dropped from a height of 4 feet onto solid concrete on any part of the container when container and contents are at or slightly below 0° F.

(3) The polyethylene container in a prescribed outer specification container, as authorized in Part 173 of this chapter, filled to 98 percent of capacity with water shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for one hour using an amplitude of one inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

Subpart C—Specifications for Cylinders

Source: 29 FR 18826, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§ 178.36 Specification 3A; seamless steel cylinders or 3AX; seamless steel cylinders of capacity over 1,000 pounds water volume.

[Order 67, 30 FR 7424, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.36-1 Compliance.

(a) Required in all details.

§ 178.36-2 Type, size and service pressure.[1]

(a) DOT-3A; seamless, not over 1,000 pounds water capacity (nominal) and service pressure at least 150 pounds per square inch.

(b) DOT-3AX; seamless, not less than 1,000 pounds water capacity and service pressure at least 500 pounds per square inch. Cylinders shall meet the following additional conditions:

(1) Assuming the cylinder to be supported horizontally at its two ends only and to be uniformly loaded over its entire length consisting of the weight per unit of length of the straight cylindrical portion filled with water and compressed to the specified test pressure; the sum of two times the maximum tensile stress in the bottom fibers due to bending (Note 1), plus that in the same fibers (longitudinal stress) (Note 2), due to hydrostatic test shall not exceed 80 percent of the minimum yield strength of the steel at such maximum stress. Wall thickness shall be increased when necessary to meet the requirement.

Note 1: To calculate the maximum longitudinal tensile stress due to bending, the following formula shall be used:

$$S=Mc/I$$

Note 2: To calculate the maximum longitudinal tensile stress due to hydrostatic test pressure, the following formula shall be used:

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[1] The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, DOT-3A2000 indicates the service pressure as 2,000 pounds per square inch.

$$S=A_1P/A_2$$

where:

S=tensile stress—p.s.i.;

M=bending moment—inch pounds $(wl^2)/8$;

w=weight per inch of cylinder filled with water;

l=length of cylinder—inches;

c=radius $(D)/(2)$ of cylinder—inches;

I=moment of inertia—$0.04909\ (D^4-d^4)$ inches fourth;

D=outside diameter—inches;

d=inside diameter—inches;

A_1=internal area in cross section of cylinder—square inches;

A_2=area of metal in cross section of cylinder—square inches;

P=hydrostatic test pressure—p.s.i.

[Order 67, 30 FR 7424, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.36-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976]

§ 178.36-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after parting and shown to be free from pipe, cracks, excessive segregation and other injurious defects.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided,* That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.36-22) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.36-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.55; phosphorous, 0.045; sulphur, 0.050.

§ 178.36-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 178.36-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.36-8 Manufacture.

(a) By best appliance and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or other defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. If not originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

§ 178.36-9 Welding or brazing.

(a) Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) Welding or brazing is authorized for the attachment of neckrings and footrings which are non-pressure parts

and only to the tops and bottoms of cylinders having a service pressure of 500 pounds per square inch or less. Cylinders, neckrings, and footrings must be made of weldable steel, carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

(2) As permitted in § 178.36-8(a).

NOTE 1: Cylinders used solely in anhydrous ammonia service may have a ½ inch diameter bar welded within their concave bottoms in accordance with the foregoing requirements.

§ 178.36-10 Wall thickness.

(a) For cylinders with service pressure less than 900 pounds the wall stress shall not exceed 24,000 pounds per square inch. Minimum wall 0.100″ for any cylinder over 5″ outside diameter.

(b) Calculation must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D=outside diameter in inches;
d=inside diameter in inches.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App A to Part 1)

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.36-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 178.36-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required adequate to prevent leakage.

§ 178.36-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d) and 173.301(g) of this chapter).

[Order 67, 30 FR 7424, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.36-14 Hydrostatic test.

(a) By water-jacket, or other suitable methods, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus the test pressure cannot be maintained the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent, volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least 5/3 times service pressure.

§ 178.36-15 Flattening test.

Between knife edges, wedge shaped, 60-degree angle, rounded to ½-inch radius; test 1 cylinder[1] taken at random out or each lot of 200 or less cylinders. Longitudinal axis of the cylinder must be at approximately a 90-degree angle to knife edges.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 178-53, 44 FR 5667, Jan. 29, 1979]

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[1] For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

§ 178.36–16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1[1] cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over $\frac{3}{16}$ inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2-percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 32 FR 48645, Oct. 19, 1978]

§ 178.36–17 Acceptable results for physical and flattening tests.

(a) Either of the following:

(1) Elongation at least 40 percent for 2-inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

(2) Elongation at least 20 percent for 2-inch gauge length or 10 percent in other cases; yield strength not over 73 percent of tensile strength; flattening required, without cracking, to 6 times wall thickness.

§ 178.36–18 Leakage test.

(a) All spun cylinders and plugged cylinders (see Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least $\frac{1}{16}$ of the total area of the bottom but not less than ¾ inch in diameter, including the closure, for at least 1 minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected. (See Note 1 to § 178.36–19.)

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 178.36–19 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

NOTE 1: Spun cylinders rejected under the provisions of § 178.36-18 may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.

§ 178.36–20 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

(1) When cylinders are constructed to § 178.36-2(a), they shall be marked DOT-3A followed by the service pressure (for example, DOT-3A1800, etc.).

(2) When cylinders are constructed to § 178.36-2(b), they shall be marked DOT-3AX followed by the service pressure (for example DOT-3AX1800, etc.)

(3) A serial [1] number and an identifying symbol (letters); location [2] of number to be just below or immediately following the DOT mark; location [2] of symbol to just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized. Examples:

DOT-3A1800

1234

XY

DOT-3A1800-1234-XY

(4) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added; and word "SPUN" or "PLUG" near DOT mark when an end closure in the finished cylinder has been welded by the spinning process, or effected by plugging.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5749, Apr. 23, 1965; Order 67, 30 FR 7424, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and further amended by Amdt. 178-40, 42 FR 2689, Jan. 13, 1977]

§ 178.36–21 Size of marks.

(a) At least ¼" high if space permits.

§ 178.36–22 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) ——————————
(Date) ——————————
Gas Cylinders
Manufactured for —————— Company
Location at ——————————
Manufactured by —————— Company
Location at ——————————
Consigned to —————— Company
Location at ——————————
Quantity——————————
Size —— inches outside diameter by —— inches long.
Marks stamped into the shoulder of the cylinder are:
Specification DOT ——— ———
Serial numbers —— to —— inclusive
Inspector's mark ——————————
Identifying symbol (registered)————
Test date ——————————
Tare weights (yes or no) ——————
Other marks (if any) ——————
These cylinders were made by process of—
————————————————
————————————————

The —————— (neckrings—footrings) permitted in § 178.36-9 were attached by process of —————— (welding—brazing).

The material used was identified by the following —————— (heat-purchase order) numbers ——————.

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ———— (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

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[1] Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches.

[2] Symbol in front of or following the number with ample space between is authorized. Other variation in location authorized only when necessitated by lack of space.

The cylinder walls were measured and the minimum thickness noted was ——— inch. The outside diameter was determined by a close approximation to be ——— inches. The wall stress was calculated to be ——— pounds per square inch under an internal pressure of ——— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-3A were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 3A except as follows:

Exceptions: ————————————

————————————————

————————————————

(Signed) ————————————
Inspector.

(Place)..
(Date)..

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered.. to .... inclusive
Size .... inches outside diameter by.. inches long
Made by .... Company
For.. Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Clyinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....

(Signed) ....
(Place)..
(Date)..

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered.. to .... inclusive
Size .... inches outside diameter by.. inches long
Made by .... Company
For.. Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) ....
(Place)..
(Date)..

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered.. to .... inclusive
Size .... inches outside diameter by.. inches long
Made by .... Company
For.. Company

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters)[1]	Permanent expansion (cubic centimeters)[1]	Percent ratio of permanent expansion to total expansion[1]	Tare weight (pounds)[2]	Volumetric capacity

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) ....

§ 178.37 Specification 3AA; seamless steel cylinders made of definitely prescribed steels or 3AAX; seamless steel cylinders made of definitely prescribed steels of capacity over 1,000 pounds water volume.

[Order 67, 30 FR 7424, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.37-1 Compliance.

(a) Required in all details.

§ 178.37-2 Type, size and service pressure.[1]

(a) DOT-3AA; seamless, not over 1,000 pounds water capacity (nominal) and service pressure at least 150 pounds per square inch.

(b) DOT-3AAX; seamless, not less than 1,000 pounds water capacity and service pressure at least 500 pounds per square inch. Cylinders shall meet the following additional conditions:

(1) Assuming the cylinder to be supported horizontally at its two ends only and to be uniformly loaded over its entire length consisting of the weight per unit of length of the straight cylindrical portion filled with water and compressed to the specified test pressure; the sum of two times the maximum tensile stress in the bottom fibers due to bending (Note 1), plus that in the same fibers (longitudinal stress) (Note 2), due to hydrostatic test shall not exceed 80 percent of the minimum yield strength of the steel at such maximum stress. Wall thickness shall be increased when necessary to meet the requirement.

NOTE 1: To calculate the maximum tensile stress due to bending, the following formula shall be used:

$$S = Mc/I$$

NOTE 2: To calculate the maximum longitudinal tensile stress due to hydrostatic test pressure, the following formula shall be used:

$$S = A_1 P / A_2$$

where:

S = tensile stress—p.s.i.;
M = bending moment—inch pounds $(wl^2)/8$;
w = weight per inch of cylinder filled with water;
l = length of cylinder—inches;
c = radius $(D)/(2)$ of cylinder—inches;
I = moment of inertia—$0.04909\ (D^4 - d^4)$ inches fourth
D = outside diameter—inches;
d = inside diameter—inches;
A_1 = internal area in cross section of cylinder—square inches;
A_2 = area of metal in cross section of cylinder—square inches;
P = hydrostatic test pressure—p.s.i.

[Order 67, 30 FR 7424, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

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[1] The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, DOT-3AA2000 indicates the service pressure as 2,000 pounds per square inch.

§ 178.37-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7), 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976]

§ 178.37-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after parting and shown to be free from pipe, cracks, excessive segregation and other injurious defects.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided* That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.37-22) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.37-5 Authorized steel.

(a) Open-hearth, basic oxygen, or electric steel of uniform quality. The following chemical analyses are authorized (See Note 1):

Designation	4130X (percent) (see note 2)	NE-8630 (percent) (see note 2)	9115 (percent) (see note 2)	9125 (percent) (see note 2)	Carbon-boron steel (percent) (see par. b)	Intermediate manganese (percent)
Carbon	0.25/0.35	0.28/0.33	0.10/0.20	0.20/0.30	0.27-0.37	0.40 max.
Manganese	0.40/0.90	0.70/0.90	0.50/0.75	0.50/0.75	0.80-1.40	1.35/1.65.
Phosphorus	0.04max	0.04 max	0.04 max	0.04 max	0.035 max	0.04 max.
Sulfur	0.05 max	0.04 max	0.04 max	0.04 max	0.045 max	0.05 max.
Silcon	0.15/0.35	0.20/0.35	0.60/0.90	0.60/0.90	0.3 max	0.10/0.30.
Chromium	0.80/1.10	0.40/0.60	0.50/0.65	0.50/0.65		
Molybdenum	0.15/0.25	0.15/0.25				
Zirconium			0.05/0.15	0.05/0.15		
Nickel		0.40/0.70				
Boron					0.0005-0.003	

NOTE 1: —A heat of steel made under the above specifications, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances shown in the following tables are not exceeded, except as approved by the Department.

CHECK ANALYSIS TOLERANCES

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Carbon	To 0.15 incl	0.02	0.03
	Over 0.15 to 0.40 incl	.03	.04
Manganese	To 0.60 incl	.03	.03
	Over 0.60 to 1.15 incl	.04	.04
	Over 1.15 to 2.50 incl	.05	.05
Phosphorus [1]	All ranges		.01
Sulphur	do		.01
Silicon	To 0.30 incl	.02	.03
	Over 0.30 to 1.00 incl	.05	.05

CHECK ANALYSIS TOLERANCES—Continued

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Nickel	To 1.00 incl	.03	.03
Chromium	To 0.90 incl	.03	.03
	Over 0.90 to 2.10 incl	.05	.05
Molybdenum	To 0.20 incl	.01	.01
	Over 0.20 to 0.40	.02	.02
Zirconium	All ranges	.01	.05

[1] Rephosphorized steels not subject to check analysis for phosphorus.

NOTE 2: This designation shall not be restrictive and the commercial steel is limited in analysis as shown in the table.

(b) When a carbon-boron steel is used, a hardenability test must be performed on the first and last ingot of each heat of steel. The results of this test must be recorded on the Record of Chemical Analysis of Material for Cylinders required by § 178.37-22 of this subpart. This hardness test must be made 5/16-inch from the quenched end of the Jominy quench bar and the hardness shall be at least Rc 33 and no more than Rc 53.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1, and paragraph (a)(4), App. A to Part 106)

[29 FR 18826, Dec. 29, 1964, as amended by 31 FR 9676, July 16, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.37-5 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.37-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 178.37-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.37-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or other defects acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. If not originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

§ 178.37-9 Welding or brazing.

(a) Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) Welding or brazing is authorized for the attachment of neckrings and footrings which are non-pressure parts, and only to the tops and bottoms of cylinders having a service pressure of 500 pounds per square inch or less. Cylinders, neckrings, and footrings must be made of weldable steel, carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

(2) As permitted in § 178.37-8.

§ 178.37-10 Wall thickness.

(a) For cylinders with service pressure less than 900 pounds the wall stress shall not exceed 24,000 pounds per square inch. Minimum wall 0.100" for any cylinder over 5" outside diameter.

(b) For cylinders with service pressure of 900 p.s.i. or more the minimum wall shall be such that the wall stress at the minimum specified test pressure shall not exceed 67 percent of the minimum tensile strength of the steel as determined from the physical tests required in §§ 178.37-16 and 178.37-17 and shall be not over 70,000 p.s.i.

(c) Calculation must be made by the formula:

$$S=P(1.3D^2+0.4d^2)/D^2-d^2$$

where

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D=outside diameter in inches;
d=inside diameter in inches.

§ 178.37-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat treated prior to tests. Heat treatment of cylinders of the authorized analyses shall be as follows:

(1) All cylinders must be quenched by oil, or other suitable medium except as provided in paragraph (a)(5) of this section.

(2) The steel temperature on quenching shall be that recommended for the steel analysis, but in no case shall exceed 1750° F.

(3) All steels shall be tempered at a temperature most suitable for that steel.

(4) The minimum tempering temperature shall be not less than 1000° F. except as noted in paragraph (a)(6) of this section.

(5) Steel 4130X may be normalized at a temperature of 1650° F. instead of being quenched and cylinders so normalized need not be tempered.

(6) Intermediate manganese steels may be tempered at temperatures not less than 1150° F., and after heat treating each cylinder must be submitted to a magnetic test to detect the presence of quenching cracks. Cracked cylinders shall be rejected and destroyed.

(7) [Reserved]

(8) Except as otherwise provided in paragraph (a)(6) of this section, all cylinders, if water quenched or quenched with a liquid producing a cooling rate in excess of 80 percent of the cooling rate of water, must be inspected by the magnetic particle, dye penetrant or ultrasonic method to detect the presence of quenching cracks. Any cylinder designed to the requirements for specification 3AA and found to have a quenching crack must be rejected and may not be requalified. Cylinders designed to the requirements for specification 3AAX and found to have cracks must have cracks removed to sound metal by mechanical means. Such specification 3AAX cylinders will be acceptable if the repaired area is subsequently examined to assure no defect, and it is determined that design thickness requirements are met.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-17, 36 FR 9521, May 26, 1971; Amdt. 178-25, 37 FR 14588, July 21, 1972]

§ 178.37-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 178.37-13 Safety devices and protection for valves, safety devices and other connections, if applied.

(a) Must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d) and 173.301(g) of this subchapter).

[Order 67, 30 FR 7424, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.37-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least 5/3 times service pressure.

§ 178.37-15 Flattening test.

Between knife edges, wedge shaped, 60-degree angle, rounded to ½-inch radius; test 1 cylinder[1] taken at random out of each lot of 200 or less cylinders. Longitudinal axis of the cylinder must be at approximately a 90-degree angle to knife edges.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 178-53, 44 FR 5667, Jan. 29, 1979]

§ 178.37-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1[1] cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches: *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.37-17 Physical and flattening tests.

(a) Acceptable results for physical and flattening tests; elongation at least 20 percent for 2" gauge length or at least 10 percent in other cases; flattening required without cracking to 6 times wall thickness.

§ 178.37-18 Leakage test.

(a) All spun cylinders and plugged cylinders (See Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least 1/16 of the total area of the bottom but not less than 3/4 inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected. (See Note 1 to § 178.37-19.)

---

[1] For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 178.37-19 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

NOTE 1: Spun cylinders rejected under the provision of § 178.37-18 may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.

§ 178.37-20 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

(1) When cylinders are constructed to § 178.37-2(a), they shall be marked DOT-3AA followed by the service pressure (for example, DOT-3AA1800, etc.).

(2) When cylinders are constructed to § 178.37-2(b), they shall be marked DOT-3AAX followed by the service pressure (for example, DOT-3AAX1800, etc.).

(3) A serial[1] number and an identifying symbol (letters); location[2] of number to be just below or immediately following the DOT mark; location[2] of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized. Examples:

DOT-3AA1800

1234

XY

DOT-3AA1800-1234-XY

(4) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added; and word "SPUN" or "PLUG" near DOT mark when an end closure in the finished cylinder has been welded by the spinning process, or effected by plugging.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5749, Apr. 23, 1965; Order 67, 30 FR 7424, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.37-20 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.37-21 Size of marks.

(a) At least 1/4" high if space permits.

§ 178.37-22 Inspector's report.

(a) Required to be clear, legible, and in the following form:

(Place) ______________________________

---

[1] Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches.

[2] Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

(Date) ————————————

Gas Cylinders

Manufactured for ———————— Company

Location at ————————————

Manufactured by ———————— Company

Location at ————————————

Consigned to ———————— Company

Location at ————————————

Quantity ————————————

Size ———— inches outside diameter by ———— inches long.

Marks stamped into the shoulder of the cylinder are:

Specification DOT ————————
Serial numbers ——— to ——— inclusive
Inspector's mark ————————
Identifying symbol (registered) ————
Test date ————————
Tare weights (yes or no) ————————
Other marks (if any) ————————

These cylinders were made by process of—

————————————

The cylinders were heat treated by the process of ————————

The ———————— (neckrings—footrings) permitted in § 178.37-9 were attached by process of ———————— (welding—brazing)

The material used was identified by the following ———————— (heat-purchase order) numbers ————————

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ———— (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was ———— inch. The outside diameter was determined by a close approximation to be ———— inches. The wall stress was calculated to be ———— pounds per square inch under an internal pressure of ———— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-3AA were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 3AA except as follows:

Exceptions: ————————————

————————————

————————————

(Signed) ————————————
Inspector.

(Place)..............................
(Date)..............................

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For.............................. Company

NOTE. Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis								
				C	P	S	Si	Mn	Ni	Cr	Mo	Zr

The analyses were made by ....

(Signed) ....
(Place)..............................
(Date) ....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength at 0.2 percent offset (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) ....
(Place) ....
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Serial Nos. of cylinders arranged tested[2] numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic[1] centimeters)	Permanent expansion (cubic centimeters)[1]	Percent ratio of permanent expansion to total expansion[1]	Tare weight (pounds)[2]	Volumetric capacity

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) ....

§ 178.38 Specification 3B; seamless steel cylinders.

§ 178.38–1 Compliance.

(a) Required in all details.

§ 178.38–2 Type, size, and service pressure.

(a) *Type and size.* Seamless; not over 1,000 pounds water capacity (nominal).

(b) *Service pressure.*[1] At least 150 to not over 500 pounds per square inch.

§ 178.38–3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

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[1] The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, DOT-3B300 indicates the service pressure as 300 pounds per square inch.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.38-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.38-22) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.38-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.55; phosphorus, 0.045; sulphur, 0.050.

§ 178.38-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 178.38-7 Defects.

(a) Material with seams, racks, laminations, or other injurious defects, not authorized.

§ 178.38-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or other defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. If not originally free from such defects, the surface may be machined or otherwise treated to eliminate these defects. The thickness of the bottoms of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

§ 178.38-9 Welding or brazing.

(a) Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) Welding or brazing is authorized for the attachment of neckrings and footrings which are non-pressure parts, and only to the tops and bottoms of cylinders having a service pressure of 500 pounds per square inch or less. Cylinders, neckrings, and footrings must be made of weldable steel, carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

(2) As permitted in § 178.38-8.

§ 178.38-10 Wall thickness.

(a) The wall stress shall not exceed 24,000 pounds per square inch. Minimum wall 0.090" for any cylinder over 6" outside diameter.

(b) Calculation must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D=outside diameter in inches;
d=inside diameter in inches.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App A to Part 1)

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.38-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 178.38-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required to be clean cut even, without checks, and to gauge.

(b) Taper threads when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 4 engaged threads are authorized; to have tight fit, and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 178.38-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d), 173.301(g) and 173.124(a) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.38-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) Each cylinder; to at least 2 times service pressure.

(2) Or, 1 cylinder out of each lot of 200 or less; to at least 3 times service pressure. Others must be examined under pressure of 2 times service pressure and show no defect.

§ 178.38-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to ½" radius; test 1 cylinder[1] taken at random out of each lot of 200 or less, after hydrostatic test.

§ 178.38-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1[1] cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches: *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

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[1] For lots of 30 or less physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.38-17 Acceptable results for physical and flattening tests.

(a) Either of the following:

(1) Elongation at least 40 percent for 2-inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

(2) Elongation at least 20 percent for 2-inch gauge length or 10 percent in other cases; yield strength not over 73 percent of tensile strength; flattening required, without cracking to 6 times wall thickness.

§ 178.38-18 Leakage test.

(a) All spun cylinders and plugged cylinders (see Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least ¹⁄₁₆ of the total area of the bottom but not less than ¾ inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected. (See Note 1 to § 178.38-19.)

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A spun cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 178.38-19 Rejected cylinders.

(a) Reheat treatment authorized, subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

NOTE 1: Spun cylinders rejected under the provisions of § 178.38-18 may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.

§ 178.38-20 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

(1) DOT-3B followed by the service pressure (for example, DOT-3B300, etc.).

(2) A serial[1] number and an identifying symbol (letters); location[2] of

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[1] Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 170 cubic inches.

[2] Symbol in front of or following the number with ample space between is also authorized. Other variation in location au-

Continued

number to be just below or immediately following the DOT mark; location[2] of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test.

The symbol must be registered with the Associate Director for OE; duplications unauthorized.

Examples:

DOT-3B300

1234

XY

DOT-3B300-1234-XY

(3) Inspector's official mark near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added; and word *"SPUN"* or *"PLUG"* near DOT mark when an end closure in the finished cylinder has been welded by the spinning process, or effected by plugging.

(b) Marking stamped into the sidewalls of cylinders having a service pressure of 150 psi is permitted only if all of the following conditions are met:

(1) Wall stress at test pressure shall not exceed 24,000 psi.

(2) Minimum wall thickness shall be not less than 0.090".

(3) Depth of stamping shall be no greater than 15 percent of the minimum wall thickness, but at no time shall it exceed 0.015".

(4) Maximum outside diameter of cylinder shall not exceed 5".

(5) Carbon content of cylinder shall not exceed 0.25 percent. If the carbon content exceeds 0.25 percent, the complete cylinder must be normalized after stamping.

(6) Stamping shall be adjacent to top head.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5749, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.38-20 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.38-21 Size of marks.

(a) At least ¼" high if space permits.

§ 178.38-22 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) ————————————————
(Date) ————————————————
Gas cylinders
Manufactured for ———————— Company
Location at ————————————————
Manufactured by ———————— Company
Location at ————————————————
Consigned to ———————— Company
Location at ————————————————
Quantity————————————————
Size ———— inches outside diameter by ———— inches long.
Marks stamped into the shoulder of the cylinder are:
Specification DOT- ————————
Serials numbers ——— to ———inclusive.
Inspector's mark ————————
Identifying symbol (registered) ————
Test date ————————
Tare weights (yes or no) ————————
Other marks (if any) ————————
These cylinders were made by process of—

————————————————————

————————————————————

The ———————— (neckrings-footrings) permitted in § 178.38-9 were attached by process of ———————— (welding-brazing)

The material used was identified by the following ———————— (heat-purchase order) numbers ————————————

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ———— (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was ——— inch. The outside diameter was determined by a close approximation to be ——— inches. The wall stress was calculated to be ——— pounds per square inch under an in-

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thorized only when necessitated by lack of space.

ternal pressure of ——— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-3B were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 3B except as follows:

Exceptions————————————

————————————

————————————

(Signed) ————————————
Inspector.

(Place)..............................
(Date)..............................

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For.............................. Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....

(Signed)..............................
(Place)..............................
(Date)..............................

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For.............................. Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed)..............................
(Place)..............................
(Date)..............................

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by .... inches long

RECORD OF HYDROSTATIC TESTS ON CYLINDERS—Continued

Made by .... Company
For .... Company

Serial Nos. of cylinders arranged tested [3] numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic [1] centimeters)	Permanent expansion (cubic cantimeters) [1]	Percent ratio of permanent expansion to total expansion [1]	Tare weight (pounds) [2]	Volumetric capacity

NOTE. When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading. "Each cylinder was subjected to a pressure of ——— pounds per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc. must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

[3] Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) ....

§ 178.39 Specification 3BN; seamless nickel cylinders.

§ 178.39-1 Compliance.

(a) Required in all details.

§ 178.39-2 Type, size and service pressure.

(a) *Type and size.* Seamless; not over 125 pounds water capacity (nominal).

(b) *Service pressure.*[1] At least 150 to not over 500 pounds per square inch.

§ 178.39-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.39-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided,* That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests, verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.39-21) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.39-5 Nickel.

(a) At least 99.0 percent pure nickel plus cobalt.

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[1] The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, DOT-3BN400 indicates the service pressure as 400 pounds per square inch.

§ 178.39–6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 178.39–7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.39–8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Cylinders closed in by spinning process not authorized.

§ 178.39–9 Welding or brazing.

(a) Welding or brazing for any purpose whatsoever is prohibited except that welding is authorized for the attachment of neckrings and footrings which are nonpressure parts, and only to the tops and bottoms of cylinders. Neckrings and footrings must be of weldable material, carbon content of which must not exceed 0.25 percent Nickel welding rod must be used.

§ 178.39–10 Wall thickness.

(a) The wall stress shall not exceed 15,000 pounds per square inch. Minimum wall 0.100″ for any cylinder over 5″ outside diameter.

(b) Calculation must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D=outside diameter in inches;
d=inside diameter in inches.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App A to Part 1)

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–64, 45 FR 81573, Dec. 11, 1980]

§ 178.39–11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 178.39–12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 6 engaged threads are authorized: to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 178.39–13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d) and 173.301(g) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–1, 33 FR 14934, Oct. 4, 1968]

§ 178.39–14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure, If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least 2 times service pressure.

§ 178.39-15 Flattening test.

(a) Between knife edges wedge shaped, 60° angle, rounded to ½" radius; test 1 cylinder[1] taken at random out of each lot of 200 or less, after hydrostatic test.

§ 178.39-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material: Required on 2 specimens cut from 1[1] cylinder taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches: *Provided*, That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.39-17 Acceptable results for physical and flattening tests.

(a) Either of the following:

(1) Elongation at least 40 percent for 2" gauge length or at least 20 percent in other cases; yield point not over 50 percent of tensile strength; flattening test not required.

(2) Elongation at least 20 percent for 2" gauge length or 10 percent in other cases; yield point not over 50 percent of tensile strength; flattening required, without cracking, to 6 times wall thickness.

§ 178.39-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding not authorized.

§ 178.39-19 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

(1) DOT-3BN followed by service pressure (for example DOT-3BN400, etc.).

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[1] For lots of 30 or less physical and flattening test are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

(2) A serial[1] number and an identifying symbol (letters); location[2] of number to be just below or immediately following the DOT mark; location[2] of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

Examples:

DOT-3BN400

1234

XY

DOT-3BN400-1234-XY

(3) Inspector's official mark, near serial number; date of test (such as 5-50 for May 1950), so placed that dates of subsequent tests can be easily added.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5749, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For additional citations to amendments to § 178.39-19 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.39-20 Size of marks.

(a) At least ¼" high if space permits.

§ 178.39-21 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) ———————————————
(Date) ———————————————
Gas cylinders
Manufactured for ——————— Company
Location at ———————————————
Manufactured by ——————— Company
Location at ———————————————
Consigned to ——————— Company
Location at ———————————————
Quantity ———————————————
Size ——————— inches outside diameter by ——————— inches long.
Marks stamped into the shoulder of the cylinder are:
Specification DOT- ———————
Serial numbers ——— to ——— inclusive.
Inspector's mark ———————
Identifying symbol (registered) ———————
Test date ———————
Tare weights (yes or no) ———————
Other marks (if any) ———————
These cylinders were made by process of—
———————————————
———————————————

The ——————— (neckrings—footrings) permitted in § 178.39-9 were attached by process of ——————— (welding-brazing).

The material used was identified by the following ——————— (heat-purchase order) numbers ———————.

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ——————— (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was ——— inch. The outside diameter was determined by a close approximation to be ——— inches. The wall stress was calculated to be ——— pounds per square inch under an internal pressure of ——— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-3BN were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 3BN except as follows:

Exceptions ———————————————
———————————————
———————————————

(Signed) ———————————————
Inspector.

(Place)..............................
(Date)..............................

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[1] Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter.

[2] Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (Serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....
(Signed) ....
(Place) ....
(Date) ....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) ....
(Place) ....
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) [1]	Permanent expansion (cubic centimeters) [1]	Percent ratio of permanent expansion to total expansion [1]	Tare weight (pounds) [2]	Volumetric capacity [2]

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without value. These weights must be accurate to a tolerance of 1 percent.

(Signed) ....

§ 178.42 Specification 3E; seamless steel cylinders.

§ 178.42-1 Compliance.

(a) Required in all details.

§ 178.42-2 Type, size, and service pressure.

(a) *Type and size.* Seamless. Must have outside diameter not greater than 2 inches nominal, length less than 2 feet.

(b) *Service pressure.*[1] Must be 1,800 pounds per square inch.

§ 178.42-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.42-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of steel by analysis or by obtaining certified analysis: *Provided,* That check analysis of samples taken from one cylinder out of each lot of 200 or less is acceptable.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.42-15) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.42-5 Steel.

(a) Open-hearth or electric steel of uniform quality. Content percent for the following not over: Carbon, 0.55; phosphorus, 0.045; sulphur, 0.050.

§ 178.42-6 Identification of steel.

(a) Required; any suitable method.

§ 178.42-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.42-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. The thickness of the spun bottom is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thickness to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position.

§ 178.42-9 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required, to be clean cut, even, without checks, and to gauge.

---

[1] The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, DOT-3E1800 indicates the service pressure as 1,800 pounds per square inch.

(b) Taper threads, when used, to be of length not less than as specified for American Standard taper pipe threads.

(c) Straight threads having at least 4 engaged threads are authorized; to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 178.42-10 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d) and 173.301(g) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.42-11 Hydrostatic test.

(a) Cylinders must be tested as follows:

(1) One cylinder out of each lot of 500 or less to be subjected to hydrostatic pressure of 6,000 pounds per square inch or higher.

(2) The cylinder referred to in paragraph (a)(1) of this section shall burst at a pressure higher than 6,000 pounds per square inch without fragmenting or otherwise showing lack of ductility, or shall hold a pressure of 12,000 pounds per square inch for 30 seconds without bursting, in which case it shall be subjected to a flattening test without cracking to six times wall thickness between knife edges, wedge shaped 60 degree angle, rounded out to ½ inch radius.

NOTE 1: Inspector's report shall be suitably changed to show results of latter alternate and flattening test.

(3) Other cylinders must be examined under pressure of at least 3,000 pounds per square inch and not to exceed 4,500 pounds per square inch and show no defect. Cylinders tested at a pressure in excess of 3,600 pounds per square inch shall burst at a pressure higher than 7,500 pounds per square inch when tested as specified in paragraph (a)(2) of this section. The pressure must be maintained for at least 30 seconds and sufficiently longer to insure complete examination.

[Order 67, 30 FR 7424, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.42-12 Leakage test.

(a) All spun cylinders and plugged cylinders (See Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least ¹⁄₁₆ of the total area of the bottom but not less than ¾ inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected. (See Note 1 to § 178.42-13.)

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 178.42-13 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

NOTE 1: Spun cylinders rejected under the provisions of § 178.42-12 may be removed from the spun cylinder category by drilling to remove defective material, tapping and plugging.

§ 178.42-14 Marking.

(a) Marking on each cylinder by stamping plainly and permanently as follows:

(1) DOT-3E1800.

(2) An identifying symbol (letters); location to be just following or below the DOT mark. The symbol and numbers must be those of the maker, or of

the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

Example:

DOT-3E1800

XY

(3) Date of test (such as 5-50 for May 1950).

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 42 FR 2689, Jan. 13, 1977]

§ 178.42-15 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) ————————————
(Date) ————————————

Steel gas cylinders

Manufactured for ———— Company
Location at ————————————
Manufactured by ———— Company
Location at ————————————
Consigned to ———— Company
Location at ————————————
Quantity ————————————
Size ———— inches outside diameter by ———— inches long

Marks stamped into the shoulder of the cylinder are:

Specification DOT-3E1800 ————
Serial numbers ——— to ——— inclusive (if numbered).
Identifying symbol (registered) ————
Test date ————————————
These cylinders were made by process of —

————————————

————————————

The steel used was identified by the following ———— (heat-purchase order) numbers ————————————

The steel used was verified as to chemical analysis and record thereof is attached hereto.

All material, such as plates, billets, and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was ——— inch. The tare weight per cylinder without valve is ——— (approx.). The volumetric capacity per cylinder is ——— (approx.).

Each and every cylinder was properly tapped with a taper thread; the threads were inspected and found to be clean-cut, of proper length, and correct as to gauge.

One finished cylinder out of each lot of 500 or less was taken at random and burst by interior pressure with the following results:

Date of test	Pressure at which cylinder ruptured

Each and every cylinder with bottom closed in by spinning was subjected to an interior gas pressure of at least 1,800 pounds per square inch and showed no leakage.

Each and every cylinder was subjected to an interior pressure of at least 3,000 pounds per square inch and showed no defect.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 3E except as follows:

Exceptions ————————————

————————————

————————————

(Signed) ————————————
(Inspector).

(Place)..............................
(Date)..............................

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For.............................. Company

Test No.	Heat No.	Check analysis No.	Cylinders represented (Serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....

(Signed) ....
(Place)..............................
(Date) ....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by.............................. inches long
Made by .... Company
For.. Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) ....
(Place)..............................
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by.............................. inches long
Made by .... Company
For.. Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading. "Each cylinder was subjected to a pressure of —— pounds per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable can but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) ....

§ 178.44 Specification 3HT; inside containers, seamless steel cylinders for aircraft use made of definitely prescribed steel.

§ 178.44-1 Compliance.

(a) Required in all details.

§ 178.44-2 Type, size and service pressure.

(a) *Type and size.* Seamless; not over 150 pounds water capacity (nominal).

(b) *Service pressure.*[1] At least 900 pounds per square inch.

§ 178.44-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 160(7), 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976]

§ 178.44-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided,* That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.44-25) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.44-5 Authorized steel.

(a) Open hearth or electric furnace steel of uniform quality. Steel of the following chemical analysis is authorized (see notes 1 and 2):

Designation	AISI 4130 (percent)
Carbon	0.28/0.33.
Manganese	0.40/0.60.
Phosphorus	0.040 maximum.
Sulfur	0.040 maximum.
Silicon	0.15/0.35.
Chromium	0.80/1.10.
Molybdenum	0.15/0.25.

CHECK ANALYSIS TOLERANCES

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Carbon	Over 0.15 to 0.40 incl	.03	.04
Manganese	To 0.60 incl	.03	.03
Phosphorus [1]	All ranges		.01
Sulphur	do		.01
Silicon	To 0.30 incl	.02	.03
	Over 0.30 to 1.00 incl	.05	.05
Chromium	To 0.90 incl	.03	.03
	Over 0.90 to 2.10 incl	.05	.05

---

[1] The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, DOT-3HT2000 indicates the service pressure as 2,000 pounds per square inch.

CHECK ANALYSIS TOLERANCES—Continued

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Molybdenum	To 0.20 incl	.01	.01
	Over 0.20 to 0.40 incl	.02	.02

[1] Rephosphorized steels not subject to check analysis for phosphorus.

NOTE 1: A heat of steel made under the specifications listed in the first table, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances shown in the second table are not exceeded, except as approved by the Department.

NOTE 2: Grain size 6 or finer according to ASTM Spec. E19-46.

[29 FR 18826, Dec. 29, 1964, as amended by Order 71, 31 FR 9075, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-55, 44 FR 21797, Apr. 12, 1979]

§ 178.44-6 Identification of material.

(a) Required; any suitable method. Steel stamping of heat identifications shall not be made in any area which will eventually become the side wall of the cylinder. Depth of stamping shall not encroach upon the minimum prescribed wall thickness of the cylinder.

§ 178.44-7 Defects.

(a) Material with seams, cracks, laminations, severe inclusions, numerous or severe draw marks, or any other injurious defect not authorized.

§ 178.44-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no fissure or other defect acceptable that is likely to weaken the finished container appreciably; the general surface finish shall not exceed a roughness of 250 RMS. Individual irregularities such as draw marks, scratches, pits, etc., should be held to a minimum consistent with good high stress pressure vessel manufacturing practices. If the cylinder is not originally free of such defects or does not meet the finish requirements, the surface may be machined or otherwise treated to eliminate these defects. The point of closure of cylinders closed by spinning is not to be less than two times the prescribed wall thickness of the cylindrical shell. Cylinder end contour shall be hemispherical or ellipsoidal with a ratio of major to minor axis not exceeding two to one and with concave side to pressure.

§ 178.44-9 Welding or brazing.

(a) Welding or brazing for any purpose whatsoever is prohibited except as follows:

(1) Welding by spinning is permitted to close the bottom of spun cylinders. Machining or grinding to produce proper surface finish at point of closure is required.

§ 178.44-10 Wall thickness.

(a) Minimum wall thickness for any cylinder shall be 0.050 inch.

(b) Minimum wall thickness shall be such that the wall stress at the minimum specified test pressure shall not exceed 75 percent of the minimum tensile strength of the steel as determined from the physical tests required in § 178.44-18 and shall not be over 105,000 psi.

(c) Calculations must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where

S=Wall stress in pounds per square inch;
P=Minimum test pressure prescribed for water jacket test;
D=Outside diameter in inches;
d=Inside diameter in inches.

(d) Wall thickness of hemispherical bottoms only permitted to 90 percent of minimum wall thickness of cylinder sidewall but shall not be less than

0.050 inch. In all other cases, thickness to be no less than prescribed minimum wall.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-14, 35 FR 13836, Sept. 1, 1970]

§ 178.44-11 Heat treatment.

(a) The completed cylinders must be uniformly and properly heated prior to tests. Heat treatment of the cylinders of the authorized analysis shall be as follows:

(1) All cylinders must be quenched by oil, or other suitable medium.

(2) The steel temperature on quenching shall be that recommended for the steel analysis, but in no case shall it exceed 1750° F.

(3) The steel shall be tempered at a temperature most suitable for the particular steel analysis but not less than 850° F.

(4) [Reserved]

(5) All cylinders must be inspected by the magnetic particle or dye penetrant method to detect the presence of quenching cracks. Any cylinder found to have a quenching crack must be rejected and may not be requalified.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-17, 36 FR 9521, May 26, 1971; Amdt. 178-25, 37 FR 14588, July 21, 1972]

§ 178.44-12 Openings in cylinders and connections (valves, fuse plugs, etc.) for those openings.

(a) Threads required to be clean cut, even, without cracks, and to gauge.

(b) Taper threads, when used, to be of length not less than as specified for National Gas Tapered Thread (NGT) as required by American Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections.[1]

(c) Straight threads having at least 6 engaged threads are authorized; to have tight fit and a calculated shear stress of at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

§ 178.44-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by applicable regulations in Part 173 of this chapter (see §§ 173.34(d), 173.301(g), 173.302(a)(2), and 173.304(a)(2) Note 7 of this chapter).

[Amdt. 178-9, 35 FR 5332, Mar. 31, 1970]

§ 178.44-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent of 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, which ever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder must be tested to at least 5/3 times service pressure.

§ 178.44-15 Cycling tests.

(a) Prior to the initial shipment of any specific cylinder design, cyclic pressurization tests shall have been performed on at least three representative samples without failure as follows:

(1) Pressurization shall be performed hydrostatically between approximately zero psig and the service pressure at a rate not in excess of 10 cycles per minute. Adequate recording instrumentation shall be provided if equipment is to be left unattended for periods of time.

(b) Tests prescribed in paragraph (a)(1) of this section shall be repeated on one random sample out of each lot of cylinders. Cylinder may then be subjected to burst test.

(c) A lot is defined as a group of cylinders fabricated from the same heat of steel, manufactured by the same process and heat treated in the same equipment under the same conditions of time, temperature, and atmosphere, and shall not exceed a quantity of 200 cylinders.

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[1] Available for a nominal charge from the American Standards Association, 70 East 45th Street, New York 17, New York and the Compressed Gas Association, Inc., 500 Fifth Avenue, New York 36, New York.

(d) All cylinders used in cycling tests must be destroyed.

§ 178.44-16 Burst test.

(a) One cylinder taken at random out of each lot of cylinders shall be hydrostatically tested to destruction.

§ 178.44-17 Flattening test.

Between knife edges, wedge shaped, 60-degree angle, rounded to ½-inch radius; test 1 cylinder[1] taken at random out of each lot of 200 or less cylinders. Longitudinal axis of the cylinder must be at approximately a 90-degree angle to knife edges.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 178-53, 44 FR 5667, Jan. 29, 1979]

§ 178.44-18 Physical tests.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1 cylinder taken at random out of each lot of cylinders.

(b) Specimens must be: Gauge length at least 24 times thickness with width not over six times thickness. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.44-19 Magnetic particle inspection.

(a) Inspection shall be performed on inside of container before closing and externally on the finished container after heat treatment. Evidence of discontinuities, which in the opinion of a qualified inspector may appreciably weaken or decrease the durability of the cylinder, shall be cause for rejection.

§ 178.44-20 Leakage test.

(a) All spun cylinders and plugged cylinders (see Notes 1 and 2) must be tested for leakage by dry gas or dry air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but not less than service pressure, must be applied to one side of the finished bottom over an area of at least ¹⁄₁₆ of the total area of the bottom but not less than ¾ inch in diameter, including the closure, for at least one minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected (see Notes 1, 2, and 3 and § 178.44-22).

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 178.44-21 Acceptable results of tests.

(a) Flattening required without cracking to ten times the wall thickness of the cylinder.

(b) Physical tests:

(1) Elongation at least 6 percent in gauge length of 24 times wall thickness.

(2) Tensile strength shall not exceed 165,000 p.s.i.

(c) Burst pressure shall be at least 4/3 times the test pressure.

(d) Cycling—at least 10,000 pressurizations.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-19, 36 FR 10785, June 3, 1971]

§ 178.44-22 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding or spinning is not authorized.

(b) For each cylinder subjected to reheat treatment during original manufacture, sidewall measurements must be made to verify that the minimum sidewall thickness meets specification requirements after the final heat treatment.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-19, 36 FR 10785, June 3, 1971]

§ 178.44-23 Marking.

(a) Cylinders shall be marked by low stress type steel stamping in an area and to a depth which will insure that the wall thickness measured from the root of the stamping to the interior surface is equal to or greater than the minimum prescribed wall thickness. Stamping must be permanent and legible. Stamping on side wall not authorized. The following markings shall appear:

(1) DOT-3HT followed by the service pressure (for example, DOT-3HT1800, etc.).

(2) A serial number and an identifying symbol (letters); location[1] of number to be just below or immediately following the DOT mark; location[1] of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

Examples:

DOT-3HT1800

1234

XY

DOT-3HT1800-1234-XY

(3) Inspector's official mark near serial number; date of test such as 5-59 for May 1959, so placed that dates of subsequent tests can be easily added; and word "SPUN" or "PLUG" near DOT mark when an end closure in the finished cylinder has been welded by the spinning process, or affected by plugging.

(4) Rejection elastic expansion (REE) in cubic centimeters (cc) near the date of test. The REE for a cylinder is 1.05 times its original elastic expansion.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5750, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For amendments to § 178.44-23 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

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[1] Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

§ 178.44-24 Name plates.

(a) Authorized, provided that they can be permanently and securely attached to the cylinder. Attachment by either brazing or welding is not permitted. Attachment by soldering is permitted provided steel temperature does not exceed 500° F.

§ 178.44-25 Inspector's report.

(a) Required to be clear, legible, and in the following form:

(Place) ————————————————————
(Date) ————————————————————
Gas Cylinders
Manufactured for ———————— Company
Location at ————————————————————
Manufactured by ———————— Company
Location at ————————————————————
Consigned to —————————— Company
Location at ————————————————————
Quantity ————————————————————
Size ———————— inches outside diameter by ———————— inches long
Marks stamped into the shoulder of the cylinder are:
  Specification DOT ————————————
  Serial numbers ——— to ——— inclusive
  Inspector's mark ————————————
  Identifying symbol (registered) ————————
Test date ————————————————————
Tare weights (yes or no) ————————————
Other marks (if any) ————————————
These cylinders were made by process of ——
The cylinders were heat treated by the process of ————————————————
The material used was identified by the following ——————————— (Heat-purchase order) numbers ————————————

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ——————————— (were—were not) marked on the material

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was ——— inch. The outside diameter was determined by a close approximation to be ——— inches. The wall stress was calculated to be ——— pounds per square inch under an internal pressure of ——— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-3HT were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 3HT except as follows:

Exceptions: ————————————————————
————————————————————————————
————————————————————————————
(Signed) ————————————————————
(Inspector),
(Place) ————————————————————
(Date) ————————————————————

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered ——————— to ——————— inclusive
Size ————————————— inches outside diameter by ————————————— inches long
Made by ————————————— Company
For ————————————————— Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (Serial Nos.)	Chemical analysis								
				C	P	S	Si	Mn	Ni	Cr	Mo	Zr

The analyses were made by ………………………………………………
(Signed) ……………………………
(Place) ……………………………
(Date) ……………………………

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength at 0.2 percent offset (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) ....
(Place) ....
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) [1]	Permanent expansion (cubic centimeters) [1]	Percent ratio of permanent expansion to total expansion [1]	Tare weight (pounds) [2]	Volumetric capacity

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) ....

§ 178.45 Specification 3T; seamless steel cylinder.

§ 178.45-1 Compliance.

Each cylinder must meet the applicable requirements of § 173.24 of this subchapter.

§ 178.45-2 Type, size, and service pressure.

(a) *Type.* Each cylinder must be of seamless construction with integrally formed heads concave to pressure at both ends. The inside head shape must be hemispherical, ellipsoidal in which the major axis is two times the minor axis, or a dished shape falling within these two limits. Permanent closures formed by spinning are prohibited.

(b) *Size.* The minimum water capacity is 1,000 pounds.

(c) *Service pressure.* The minimum service pressure is 1,800 p.s.i.

§ 178.45-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976]

§ 178.45-4 Duties of the Inspector.

(a) The inspector must determine that all materials are in compliance with the requirements of this specification.

(b) The inspector must verify compliance with the requirements of § 178.45-5 by making a chemical analysis or obtaining a certified chemical analysis from the material manufacturer for each heat of material. If an analysis is not provided by the material manufacturer, a sample from each heat must be analyzed.

(c) The inspector must determine that each cylinder is made and marked in compliance with this specification by:

(1) Complete internal and external inspection;

(2) Verification of proper heat treatment;

(3) Selection of samples to be tested;

(4) Witnessing all tests;

(5) Verification of threads by gauge; and

(6) Preparation of required report.

§ 178.45-5 Material, steel.

(a) Only open hearth, basic oxygen, or electric furnace process steel of uniform quality is authorized. The steel analysis must conform to the following:

ANALYSES TOLERANCES

Element (percent)	Ladle analysis	Check analysis	
		Under	Over
Carbon	0.35 to 0.50	0.03	0.04
Manganese	0.75 to 1.05	0.04	0.04
Phosphorus (max)	0.035		0.01
Sulfur (max)	0.04		0.01
Silicon	0.15 to 0.35	0.02	0.03
Chromium	0.80 to 1.15	0.05	0.05
Molybdenum	0.15 to 0.25	0.02	0.02

(b) A heat of steel made under these specifications, the ladle analysis of which is slightly out of the specified range, is acceptable if satisfactory in all other aspects. However, the check analysis tolerances shown in the above table may not be exceeded except as approved by the Department.

(c) Material with seams, cracks, laminations, or other injurious defects is not permitted.

(d) Material used must be identified by any suitable method.

§ 178.45-6 Manufacture.

(a) General manufacturing requirements are as follows:

(1) Dirt and scale must be removed prior to inspection and processing.

(2) Surface finish must be uniform and reasonably smooth.

(3) Inside surfaces must be clean, dry, and free of loose particles.

(4) No defect of any kind is permitted if it is likely to weaken a finished cylinder.

(b) If the cylinder surface is not originally free from the defects described in paragraph (a) of this section, the surface may be machined or otherwise treated to eliminate these defects provided the minimum wall thickness is maintained.

(c) Welding or brazing on a cylinder is not permitted.

§ 178.45-7 Wall thickness.

(a) The minimum wall thickness must be such that the wall stress at the minimum specified test pressure does not exceed 67 percent of the minimum tensile strength of the steel as determined by the physical tests required in §§ 178.45-14 and 178.45-15. A wall stress of more than 90,500 p.s.i. is not permitted. The minimum wall thickness for any cylinder may not be less than 0.225 inch.

(b) Calculation of the stress for cylinders must be made by the following formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where:

S=Wall stress in pounds per square inch;
P=Minimum test pressure, at least 5/3 service pressure;
D=Outside diameter in inches;
d=Inside diameter in inches.

(c) Each cylinder must meet the following additional requirements which assumes a cylinder horizontally supported at its two ends and uniformally loaded over its entire length. This load consists of the weight per inch of length of the straight cylindrical portion filled with water compressed to the specified test pressure. The wall thickness must be increased when necessary to meet this additional requirement.

(1) The sum of two times the maximum tensile stress in the bottom fibers due to bending (see paragraph (c)(1)(i) of this section), plus the maximum tensile stress in the same fibers due to hydrostatic testing (see paragraph (c)(1)(ii) of this section) may not exceed 80 percent of the minimum yield strength of the steel at this maximum stress.

(i) The following formula must be used to calculate the maximum tensile stress due to bending:

$$S=Mc/I$$

where:

S=Tensile stress in pounds per square inch;
M=Bending moment in inch-pounds ($wl^2/8$)
I=Moment of inertia-0.04909 (D^4-d^4) in inches fourth;
c=Radius ($D/2$) of cylinder in inches;
w=Weight per inch of cylinder filled with water;
l=Length of cylinder in inches;
D=Outside diameter in inches;
d=Inside diameter in inches.

(ii) The following formula must be used to calculate the maximum longitudinal tensile stress due to hydrostatic test pressure:

$$S=A_1P/A_2$$

where:

S=Tensile stress in pounds per square inch;
A_1=Internal area in cross section of cylinder in square inches;
P=Hydrostatic test pressure in pounds per square, inch;
A_2=Area of metal in cross section of cylinder in square inches.

§ 178.45-8 Heat treatment.

(a) Each completed cylinder must be uniformly and properly heat treated prior to testing, as follows:

(1) Each cylinder must be heated and held at the proper temperature for at least one hour per inch of thickness based on the maximum thickness of the cylinder and then quenched in a suitable liquid medium having a cooling rate not in excess of 80 percent of water. The steel temperature on quenching must be that recommended for the steel analysis, but it must never exceed 1750° F.

(2) After quenching, each cylinder must be reheated to a temperature below the transformation range but not less than 1050° F., and must be held at this temperature for at least one hour per inch of thickness based on the maximum thickness of the cylinder. Each cylinder must then be cooled under conditions recommended for the steel.

§ 178.45-9 Openings.

(a) Openings are permitted on heads only.

(b) The size of any centered opening in a head may not exceed one half the outside diameter of the cylinder.

(c) Openings in a head must have ligaments between openings of at least three times the average of their hole diameter. No off-center opening may exceed 2.625 inches in diameter.

(d) All openings must be circular.

(e) All openings must be threaded. Threads must be in compliance with the following:

(1) Each thread must be clean cut, even, without any checks, and to gage.

(2) Taper threads, when used, must be the American Standard Pipe thread (NPT) type and must be in compliance with the requirements of NBS Handbook H-28, Part II, Section VII.

(3) Taper threads conforming to National Gas Taper thread (NGT) standards must be in compliance with the requirements of NBS Handbook H-28, Part II, Sections VII and IX.

(4) Straight threads conforming with National Gas Straight thread (NGS) standards are authorized. These threads must be in compliance with the requirements of NBS Handbook H-28, Part II, Sections VII and IX.

§ 178.45-10 Safety devices and protection for valves, safety devices, and other connections.

Safety devices and protection arrangements for valves, safety devices, and other connections must be in compliance with § 173.34(d) of this subchapter. See also § 173.301(l) of this subchapter.

§ 178.45-11 Hydrostatic test.

(a) Each cylinder must be tested at an internal pressure by the water jacket method or other suitable method. The testing apparatus must be operated in a manner that will obtain accurate data. Any pressure gage used must permit reading to an accuracy of one percent. Any expansion gage used must permit reading of the total expansion to an accuracy of one percent.

(b) Any internal pressure applied to the cylinder after heat treatment and before the official test may not exceed 90 percent of the test pressure.

(c) The pressure must be maintained sufficiently long to assure complete expansion of the cylinder. In no case may the pressure be held less than 30 seconds.

(d) If, due to failure of the test apparatus, the required test pressure cannot be maintained, the test must be repeated at a pressure increased by 10 percent or 100 p.s.i., whichever is lower or, the cylinder must be reheat treated.

(e) Permanent volumetric expansion of the cylinder may not exceed 10 percent of its total volumetric expansion at the required test pressure.

(f) Each cylinder must be tested to at least 5/3 times its service pressure.

§ 178.45-12 Ultrasonic examination.

After the hydrostatic test, the cylindrical section of each vessel must be examined in accordance with ASTM Standard A-388-67 using the angle beam technique. The equipment used must be calibrated to detect a notch equal to five percent of the design minimum wall thickness. Any discontinuity indication greater than that produced by the five percent notch shall be cause for rejection of the cylinder unless the discontinuity is repaired within the requirements of this specification.

§ 178.45-13 Basic requirements for tension and Charpy impact tests.

(a) When the cylinders are heat treated in a batch furnace, two tension specimens and three Charpy impact specimens must be tested from one of the cylinders or a test ring from each batch. The lot size represented by these tests may not exceed 200 cylinders.

(b) When the cylinders are heat treated in a continuous furnace, two tension specimens and three Charpy impact specimens must be tested from one of the cylinders or a test ring from each four hours or less of production. However, in no case may a test lot based on this production period exceed 200 cylinders.

(c) Each specimen for the tension and Charpy impact tests must be taken from the side wall of a cylinder or from a ring which has been heat treated with the finished cylinders of which the specimens must be representative. The axis of the specimens must be parallel to the axis of the cylinder. Each cylinder or ring specimen for test must be of the same diameter, thickness, and metal as the finished cylinders they represent. A test ring must be at least 24 inches long with ends covered during the heat treatment process so as to simulate the heat treatment process of the finished cylinders it represents.

(d) A test cylinder or test ring need represent only one of the heats in a furnace batch provided the other heats in the batch have previously been tested and have passed the tests and that such tests do not represent more than 200 cylinders from any one heat.

(e) The test results must conform to the requirements specified in §§ 178.45-14 and 178.45-15.

(f) When the test results do not conform to the requirements specified, the cylinders represented by the tests may be reheat treated and the tests repeated. Paragraph (e) of this section applies to any retesting.

§ 178.45-14 Basic conditions for acceptable physical testing.

(a) The following criteria must be followed to obtain acceptable physical test results:

(1) Each tension specimen must have a gage length of two inches with a width not exceeding one and one-half inches. Except for the grip ends, the

specimen may not be flattened. The grip ends may be flattened to within one inch of each end of the reduced section.

(2) A specimen may not be heated after heat treatment specified in § 178.45-8.

(3) The yield strength in tension must be the stress corresponding to a permanent strain of 0.2 percent of the gage length.

(i) This yield strength must be determined by the "offset" method or the "extension under load" method described in ASTM Standard E8-69.

(ii) For the "extension under load" method, the total strain (or extension under load) corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gage length under appropriate load and adding thereto 0.2 percent of the gage length. Elastic extension calculations must be based on an elastic modulus of 30,000,000. However, when the degree of accuracy of this method is questionable the entire stress-strain diagram must be plotted and the yield strength determined from the 0.2 percent offset.

(iii) For the purpose of strain measurement, the initial strain must be set with the specimen under a stress of 12,000 p.s.i. and the strain indicator reading set at the calculated corresponding strain.

(iv) The cross-head speed of the testing machine may not exceed ⅛ inch per minute during the determination of yield strength.

(4) Each impact specimen must be Charpy V-notch type size 10 mm x 10 mm taken in accordance with paragraph 11 of ASTM Standard A-333-67. When a reduced size specimen is used, it must be the largest size obtainable.

§ 178.45-15 Acceptable physical test results.

(a) Results of physical tests must conform to the following:

(1) The tensile strength may not exceed 155,000 p.s.i.

(2) The elongation must be at least 16 percent for a two-inch gage length.

(3) The Charpy V-notch impact properties for the three impact specimens which must be tested at 0° F. may not be less than the values shown below:

Size of specimen (mm)	Average value for acceptance 3 specimens	Minimum value 1 specimen only of the three
10.0x10.0	25.0 ft. lbs	20.0 ft. lbs.
10.0x7.5	21.0 ft. lbs	17.0 ft. lbs.
10.0x5.0	17.0 ft. lbs	14.0 ft. lbs.

(4) After the final heat treatment, each vessel must be hardness tested on the cylindrical section. The tensile strength equivalent of the hardness number obtained may not be more than 165,000 p.s.i. (Rc 36). When the result of a hardness test exceeds the maximum permitted, two or more retests may be made; however, the hardness number obtained in each retest may not exceed the maximum permitted.

§ 178.45-16 Rejected cylinders.

(a) Reheat treatment is authorized. However, each reheat treated cylinder must subsequently pass all the prescribed tests.

(b) Repair by welding is not authorized.

§ 178.45-17 Markings.

(a) Marking must be done by stamping into the metal of the cylinder. All markings must be legible and located on a shoulder.

(b) Required markings are as follows:

(1) "DOT-3T," followed by the service pressure (for example: "DOT-3T1800");

(2) The appropriate serial number;

(3) The registration number of the manufacturer ("M ****");

(4) The inspector's official mark near the serial number;

(5) The tare weight in pounds; and

(6) The date of the test (for example "5-72" for May 1972), so placed that dates of subsequent tests may be easily added.

(c) Markings must be at least ½ inch high.

(d) The markings prescribed by paragraphs (b)(1), (2), and (3) of this section must be displayed one immediately below the previous one as follows:

DOT-3T1800

1234

M 6789

(e) No person may mark any cylinder with the specification identification "DOT-3T" unless (1) it was manufactured in compliance with the requirements of this section and (2) its manufacturer has a registration number (M ****) from the Office of Hazardous Materials, Department of Transportation, Washington, D.C. 20590.

§ 178.45-18 Inspector's report.

(a) The inspector's report must be retained indefinitely by the manufacturer as long as DOT-3T cylinders are authorized for use by these regulations and a copy must be supplied the purchaser and owner of each cylinder. Upon sale by the original purchaser or owner, the seller must furnish the buyer a copy of the report. The manufacturer and owner must keep all reports available for examination upon request by representatives of the Department.

(b) Each report must be legible, and contain at least the following information:

INSPECTION REPORT COVERING THE MANUFACTURE OF SPECIFICATION DOT-3T CYLINDERS

The cylinders covered by this report were manufactured for ———— located at ————. They were manufactured by ———— located at ————. The cylinders are ——— inches in diameter (OD), ——— inches in length, and have a minimum wall thickness of ——— inches. The calculated stress is ——— p.s.i. under a test pressure of ——— p.s.i. The marks stamped into the shoulder of the cylinder are:

Specification DOT————;
Serial numbers ——— to ——— inclusive;
Inspector's mark ———;
DOT registration number M ———;
Tare weight ———;
Test date ———;
Other marks (if any) ——————.

These cylinders were made by process of ———. The cylinders were heat treated by the process of ———. The metal used was identified by the following ———— numbers ———— (heat-purchase order). The metal used was verified as to chemical analysis as shown in the "Record of Chemical Analysis of Metal" attached hereto. The heat numbers ———— (were—were not) marked on the metal.

All material was inspected visually and by ultrasonic means and all that was accepted was found free of injurious defects which might significantly affect the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were observed and found satisfactory.

The cylinder walls and outside diameter were measured and the calculated stress for the cylinder design covered herein was verified.

Hydrostatic test, physical tests of the material, and other tests as prescribed in specification DOT-3T were made in the presence of the inspector. All materials, tests results, and cylinders accepted were found to be in compliance with the requirements of that specification and records therefor are attached hereto.

I hereby certify that all these cylinders proved satisfactory in every way and are in compliance with the requirements of Department of Transportation Specification 3T.

Inspector's name ——————————
(Print)
Signed ——————————————
(Inspector)
Inspector's Employer ————————
(Name and address)

(Place)..
(Date)..

RECORD OF CHEMICAL ANALYSIS OF MATERIALS FOR CYLINDERS

Numbered.................................... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For. .... Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file." or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (Serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Cr	Mo

The analyses were made by ....

(Signed) ....

Inspector's name ....

(Print)

Inspector's employer ....

(Name and address)

(Place) ....

(Date) ....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered .... to .... inclusive

Size .... inches outside diameter by .... inches long

Made by .... Company

For .... Company

Test No.	Cylinders represented by test (serial nos.)	Yield strength at 0.2 percent offset (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 2 inches)	Reduction of area (percent)	Charpy V-notch	
						Average value for 3 specimens	Minimum value for one specimen

(Signed) ....

Inspector's name ....

(Print)

Inspector's employer ....

(Name and address)

....

(Place) ....

(Date) ....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered .... to .... inclusive

Size .... inches outside diameter by .... inches long

Made by .... Company

For .... Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) [1]	Permanent expansion (cubic centimeters) [1]	Percent ratio of permanent expansion to total expansion [1]	Tare weight (pounds) [2]	Volumetric capacity

---

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic date, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] State whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) ....

Inspector's name ....

(Print)

Inspector's employer ....

(Name and address)

....

[Amdt. 178-27, 38 FR 21990, Aug. 15, 1973, as amended by 38 FR 22552, Aug. 22, 1973]

§ 178.47 Specification 4DS; inside containers, welded stainless steel for aircraft use.

§ 178.47-1 Compliance.

(a) Required in all details.

§ 178.47-2 Type, size, and service pressure.

(a) Type and size, welded stainless steel spheres (two seamless hemispheres) or circumferentially welded cylinders not over 100 pounds water capacity.

(b) Service pressure.[1] At least 500 to not over 900 pounds per square inch.

§ 178.47-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(F)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976]

§ 178.47-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis; provided, that a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one container out of each lot of 200 or less.

(c) Verify compliance of containers with all requirements including markings; inspect inside before closing; verify heat treatment and welding procedure as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gage; report volumetric capacity and tare weight and minimum thickness of wall noted. Verify that all tests are conducted at temperatures between 60° F. and 90° F.

(d) Render complete report to purchaser, container maker, and the Associate Director for OE.

§ 178.47-5 Steel.

(a) Types 304, 321 and 347 stainless steel are authorized with proper welding procedure and complying with the following analyses:

	Stainless steels		
	304 (percent	321 (percent)	347 (percent)
Carbon (maximum)	0.08	0.08	0.08
Manganese (maximum)	2.00	2.00	2.00
Phosphorus (maximum)	.030	.030	.030
Sulfur (maximum)	.030	.030	.030
Silicon (maximum)	.75	.75	.75
Nickel	8.0/11.0	9.0/13.0	9.0/13.0
Chromium	18.0/20.0	17.0/20.0	17.0/20.0
Molybdenum			
Titanium		(1)	
Columbium			(2)

[1] Titanium shall be not less than 5×C and not more than 0.60%.

[2] Columbium shall be not less than 10×C and not more than 1.0%.

NOTE 1: A heat of steel made under the above specifications, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances shown in the following table are not exceeded, except as approved by the Department:

---

[1] The "service pressure" limits the use of the container. It is shown by marks on container; for example DOT-4DS500 indicates the service pressure as 500 pounds per square inch.

CHECK ANALYSIS TOLERANCES

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Carbon	To 0.15 incl	0.01	0.01
Manganese	Over 1.15 to 2.50 incl	0.05	0.05
Phosphorus [1]	All ranges		0.01
2Sulphur	All ranges		0.01
Silicon	Over 0.30 to 1.00 incl	0.05	0.05
Nickel	Over 5.30 to 10.00 incl	0.10	0.10
	Over 10.00 to 14.00 incl	0.15	0.15
Chromium	Over 15.00 to 20.00 incl	0.20	0.20
Titanium	All ranges	0.05	0.05
Columbium	All ranges	0.05	0.05

[1] Rephosphorized steels not subject to check analysis for phosphorus.

[29 FR 18826, Dec. 29, 1964, as amended by Order 71, 31 FR 9075, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.47-6 Identification of material.

(a) Required; any suitable method.

§ 178.47-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized. Defects in welded joints shall not exceed the limits specified in § 178.47-16 covering radiographic inspection.

§ 178.47-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished container appreciably, reasonably smooth and uniform surface finish required. No abrupt change in wall thickness permitted. Certification of welders and/or process is required in accordance with the sections of CGA Pamphlet C-3 that apply.

(b) All seams of the sphere or cylinder must be fusion welded. Seams shall be of the butt type and means must be provided for accomplishing complete penetration of the joint.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18248, Nov. 14, 1969]

§ 178.47-9 Attachments.

(a) Attachments to the container are authorized by fusion welding provided that such attachments are made of weldable stainless steel in accordance with § 178.47-5.

§ 178.47-10 Wall thickness.

(a) The minimum wall thickness shall be such that the wall stress at the minimum specified test pressure shall not be over 60,000 psi. Minimum wall 0.040 inch for any diameter container.

(b) Calculation for sphere must be made by the formula:

$$S=PD/4tE$$

where

S=Wall stress in pounds per square inch;
P=Test pressure prescribed for water jacket test, i.e., at least two times service pressure, in pounds per square inch;
D=Outside diameter in inches;
t=Minimum wall thickness in inches;
E=0.85 (provides 85 percent weld efficiency factor which must be applied in the girth weld area and heat zones which zone shall extend a distance of 6 times wall thickness from center of weld);
E=1.0 (for all other areas).

(c) Calculation for a cylinder must be made by the formula:

$$S=P[(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where

S=Wall stress in pounds per square inch;
P=Test pressure prescribed for water jacket test, i.e., at least two times serv-

ice pressure, in pounds per square inch;

D=Outside diameter in inches;

d=Inside diameter in inches.

§ 178.47-11 Heat treatment.

(a) The seamless hemispheres and cylinders may be stress relieved or annealed for forming. Welded container shall be stress relieved at a temperature of 775° F.±25° after process treatment and before hydrostatic test.

§ 178.47-12 Openings in container.

(a) Each opening in the container must be provided with a fitting, boss or pad of weldable stainless steel securely attached to the container by fusion welding.

(b) Attachments to a fitting, boss, or pad must be adequate to prevent leakage. Threads must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the container; gaskets required, adequate to prevent leakage.

§ 178.47-13 Safety relief devices.

(a) Safety relief devices must be as required by Department of Transportation Regulations (see § 173.34(d) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14943, Oct. 4, 1968]

§ 178.47-14 Process treatment.

(a) Each container shall be hydraulically pressurized in a water jacket to at least 100 percent, but not more than 110 percent, of the test pressure and maintained at this pressure for a minimum of 3 minutes. Total and permanent expansion shall be recorded and included in the inspector's report.

§ 178.47-15 Hydrostatic test.

(a) By water-jacket, operated so as to obtain accurate data. Pressure gauge must permit reading to an accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each container must be tested to at least 2 times service pressure.

(e) Container will then be inspected. Wall thickness lower than that required by § 178.47-10 shall be cause for rejection. Bulges and cracks shall be cause for rejection. Weld joint defects exceeding requirements of § 178.47-16 shall be cause for rejection.

§ 178.47-16 Radiographic inspection.

(a) Required on all welded joints which are subjected to internal pressure, except that at the discretion of the disinterested inspector, openings less than 25 percent of the container diameter need not be subjected to radiographic inspection. Evidence of any defects likely to seriously weaken the container shall be cause for rejection.

(b) Radiographic inspection shall be performed subsequent to hydrostatic test.

§ 178.47-17 Burst test.

(a) One container taken at random out of 200 or less shall be hydrostatically tested to destruction. Rupture pressure shall be included as part of the inspector's report.

§ 178.47-18 Flattening test.

(a) *Flattening test for spheres.* At the weld between parallel steel plates on a press with welded seam at right angles to the plates, test one sphere taken at random out of each lot of 200 or less after hydrostatic test. Any projecting appurtenances may be cut off (by mechanical means only) prior to crushing.

(b) *Flattening test for cylinders.* Between knife edges, wedge shaped, 60°

angle, rounded to ½-inch radius; test one cylinder taken at random out of each lot of 200 or less, after hydrostatic test.

§ 178.47-19 Acceptable results for flattening and burst tests.

(a) Flattening required to 50 percent of the original outside diameter without cracking.

(b) Burst pressure shall be at least 3 times service pressure.

§ 178.47-20 Rejected containers.

(a) Repair of welded seams by welding prior to process treatment authorized; subsequent thereto containers must be heat treated and pass all prescribed tests.

§ 178.47-21 Marking.

(a) Marking on each container by stamping plainly and permanently only on a permanent attachment or on a metal nameplate permanently secured to the container by means other than soft solder, as follows:

(1) DOT-4DS followed by the service pressure (for example: DOT-4DS900).

(2) A serial number and an identifying symbol (letters) location of a number to be just below the DOT mark; location of symbol to be just below the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE, duplications unauthorized:

Example:

DOT-4DS900

1234

XY

(3) Inspector's official mark, near serial number, date of test (such as 8-61 for August 1961) so placed that dates of subsequent tests can be easily added.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 42 FR 2689, Jan. 13, 1977]

§ 178.47-22 Size of marks.

(a) Of sufficient size to be legible.

§ 178.47-23 Inspector's report.

(a) Required to be clear, legible, and in the following form:

(Place) ————————————————
(Date) ————————————————
Gas ————————————————

Spheres-cylinders

Manufactured for ———————— Company
Location at ————————————————
Manufactured by ———————— Company
Location at ————————————————
Consigned to ———————— Company
Location at ————————————————
Quantity ————————————————
Size ———————— inches outside diameter by ———————— inches long
Marks stamped into the ————————
(shoulder-metal plate, § 178.47-21)
Specification DOT ————————
Serial numbers ———————— Inclusive
Inspector's mark ————————
Identifying symbol (registered) ————————
Test date ————————————————
Tare weights (yes or no) ————————
Other marks (if any) ————————
These containers were made by process of
————————————————

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ———————— (were—were not) marked on the material.

All material, such as plates and seamless tubing, was inspected and each container was inspected both before and after closing in the ends; all that were accepted were found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the container. The processes of manufacture of containers were supervised and found to be efficient and satisfactory.

The container walls were measured and the minimum thickness noted was ———— inch. The outside diameter was determined by a close approximation to be ———— inches. The wall stress was calculated to be ———— pounds per square inch under an internal pressure of ———— pounds per square inch.

Hydrostatic tests, flattening tests and other tests, as prescribed in specification No. DOT-4DS were made in the presence of the inspector and all material and containers accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these containers proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 4DS except as follows:

Exceptions:

————————————————

————————————————

————————————————

(Signed) ————————————
(Inspector)

(Place) ————————————

(Date) ————————————

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CONTAINERS

Numbered ———————— inclusive

Size ———— inches outside diameter by ———— inches long

Made by ———————— Company

For ———————— Company

NOTE: Any omission of analysis by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (Serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....

(Signed) ....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CONTAINERS

Numbered .... to .... inclusive

Size .... inches outside diameter by .... inches long

Made by .... Company

For .... Company

Test No.	Containers represented by test (serial Nos.)	Rupture pressure (pounds per square inch)	Flattening test

(Signed) ....

(Place) ....

(Date) ....

RECORD OF HYDROSTATIC TESTS ON CONTAINERS

Numbered .... to .... inclusive

Size .... inches outside diameter by .... inches long

Made by .... Company

For .... Company

Serial numbers of containers tested arranged numerically	Process pressure (pounds per square inch)	Total expansion at process pressure (cubic centimeters)	Permanent expansion at process pressure (cubic centimeters)	Actual test pressure (pounds per square inch)	Total expansion at test pressure (cubic centimeters)	Permanent expansion at test pressure (cubic centimeters)	Percent ratio of permanent expansion to total expansion	Tare weight (pounds)	Volumetric capacity

NOTE: When specifications require test for only one out of each lot of 200 or less containers, the check on the others must be indicated by a notation hereon reading. "Each container was subjected to pressure of —— pounds per square inch and shows no defect."

(Signed) ....

§ 178.50 Specification 4B; welded and brazed steel cylinders.

§ 178.50-1 Compliance.

(a) Required in all details.

§ 178.50-2 Type, size, and service pressure.

(a) *Type and size.* Must be welded or brazed type; longitudinal seams must be forged lap-welded or brazed; not over 1,000 pounds water capacity (nominal). Cylinders closed in by spinning process not authorized.

(b) *Service pressure.*[1] At least 150 to not over 500 pounds per square inch.

§ 178.50-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.50-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.50-21) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.50-5 Steel.

(a) Open-hearth, electric or basic oxygen process steel of uniform quality. Content percent for the following not over: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050.

§ 178.50-6 Identification of material.

(a) Required: Any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

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[1] The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder, for example, DOT-4B300 indicates the service pressure as 300 pounds per square inch.

§ 178.50-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.50-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Exposed bottom welds on cylinders over 18″ long must be protected by footrings. Seams must be made as follows:

(1) Circumferential seams: By welding or by brazing. Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swedged, or curled over the skirt or flange of the head, and be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.

(2) Longitudinal seams in shells: By forged lap welding, by copper brazing, by copper alloy brazing, or by silver alloy brazing. Copper alloy composition must be: Copper, 95 percent minimum; Silicon, 1.5 percent to 3.85 percent; Manganese, 0.25 percent to 1.10 percent. The melting point of the silver alloy brazing material must be in excess of 1000° F. When brazed, the plate edge must be lapped at least eight times the thickness of plate, laps being held in position, substantially metal to metal, by riveting or electric spot-welding; brazing must be done by using a suitable flux and by placing brazing material on one side of seam and applying heat until this material shows uniformly along the seam of the other side.

§ 178.50-9 Welding or brazing.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized: *Provided,* That such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

§ 178.50-10 Wall thickness.

(a) For outside diameters over 6″ the minimum wall thickness shall be 0.090 inch. In any case the minimum wall thickness shall be such that calculated wall stress at minimum test pressure (§ 178.50-14(d)) shall not exceed the following values:

(1) 24,000 pounds per square inch for cylinders without longitudinal seam;

(2) 22,800 pounds per square inch for cylinders having copper brazed or silver alloy brazed longitudinal seam;

(3) 18,000 pounds per square inch for cylinders having forged lapped welded longitudinal seam.

(b) Calculation must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test or 450 pounds per square inch whichever is the greater;
D=outside diameter in inches;
d=inside diameter in inches.

§ 178.50-11 Heat treatment.

(a) Body and heads formed by drawing or pressing must be uniformly and properly heat treated prior to tests.

§ 178.50-12 Opening in cylinders.

(a) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing or by welding or by threads. Fitting, boss, or pad must be of steel suitable for the method of attachment employed, and which need not be identified or verified as to analysis except that if attachment is by welding, carbon content must not exceed 0.25 percent. If threads are used, they must comply with the following:

(1) Threads must be clean cut, even without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

NOTE 1: A brass fitting may be brazed to the steel boss or flange on cylinders used as component parts of hand fire extinguishers.

(b) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 178.50-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d), 173.301(g) and 173.124(a) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.50-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) At least one cylinder selected at random out of each lot of 200 or less shall be tested as outlined in paragraphs (a), (b), and (c) of this section to at least two times service pressure.

(2) All cylinders not tested as outlined in paragraph (d)(1) of this section must be examined under pressure of at least two times service pressure and show no defect.

§ 178.50-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to ½" radius; test 1 cylinder[1] taken at random out of each lot of 200 or less, after hydrostatic test.

§ 178.50-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1[1] cylinder, or part thereof heat-treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "ex-

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[1] For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

tension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.50-17 Acceptable results for physical and flattening tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

Exception: Flattening test is required, without cracking, to 6 times wall thickness when cylinders are made of lap-welded pipe; in such case rings (crop ends) cut from each end of pipe must be tested with weld 45° or less from point of greatest stress; if a ring fails, another from the same end of pipe may be tested.

§ 178.50-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair of brazed seams by brazing and welded seams by welding is authorized.

§ 178.50-19 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, neck or valve protection collar which is permanently attached to the cylinders and forming an integral part thereof, provided that cylinders not less than 0.090 inches thick may be stamped on the side wall adjacent to top head, as follows:

(1) DOT-4B followed by the service pressure (for example, DOT-4B300, etc.).

(2) A serial[1] number and an identifying symbol (letters); location[2] of number to be just below or immediately following the DOT mark; location[2] of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

Examples:

DOT-4B300

1234

XY

DOT-4B300-1234-XY

(3) Inspector's official mark, near serial number; date of test (such as 5-50 for May 1950), so placed that date of subsequent test can be easily added.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5750, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.50-19 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.50-20 Size of marks.

(a) At least ¼" high if space permits.

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[1] Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 170 cubic inches.

[2] Symbol in front of or following the number with ample space between or symbol and serial number stamped into welded or brazed-on valve spud directly above the DOT specification mark located on head of cylinder are also authorized. Other variations in location authorized only when necessitated by lack of space.

§ 178.50-21 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) ————————————
(Date) ————————————
Gas cylinders
Manufactured for —————— Company
Location at ————————————
Manufactured by —————— Company
Location at ————————————
Consigned to ———————— Company
Location at ————————————
Quantity ————————————
Size —— inches outside diameter by —— inches long.
Marks stamped into the shoulder of the cylinder are:
Specification DOT ————————
Serial numbers —— to —— inclusive.
Inspector's mark ————————
Identifying symbol (registered) ————
Test date ————————————
Tare weight (yes or no) ——————
Other marks (if any) ——————
These cylinders were made by process of —

——————————————————

——————————————————

The ———————— (neckrings, footrings, etc.) permitted in § 178.50-9 were attached by process of ——————— (welding—brazing)

The material used was identified by the following ——————— (heat-purchase order) numbers ————————————

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ———————— (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was —— inch. The outside diameter was determined by a close approximation to be —— inches. The wall stress was calculated to be —— pounds per square inch under an internal pressure of —— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material and other tests, as prescribed in specification No. DOT-4B were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 4B except as follows:

Exceptions: ————————————

——————————————————

——————————————————

(Signed) ————————————
Inspector.

(Place)..............................
(Date)..............................

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered.............................. to .... inclusive
Size.............................. inches outside diameter by.............................. inches long
Made by .... Company
For.. Company

NOTE: Any commission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....
(Signed) ....
(Place)..............................
(Date)..............................

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.[1]	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) ....
(Place) ....
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters)[1]	Permanent expansion (cubic centimeters)[1]	Percent ratio of permanent expansion to total expansion[1]	Tare weight (pounds)[2]	Volumetric capacity[3]

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading: "Each cylinder was subjected to a pressure of pounds ———— per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

[3] Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) ....

§ 178.51 Specification 4BA; welded or brazed steel cylinders made of definitely prescribed steels.

§ 178.51-1 Compliance.

(a) Required in all details.

§ 178.51-2 Type, size, and service pressure.

(a) Must be welded or brazed type; not over 1,000 pounds water capacity (nominal); service pressure at least 225 and not over 500 pounds per square inch gauge. Closures welded by the spinning process not permitted.

§ 178.51-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.51-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements of this specification. For cylinders made by the billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with specification requirements including: markings; condition of inside; tests; threads; heat treatment. Obtain samples for all tests, and check chemical analyses, witness all tests; report volumetric capacity, tare weight (see report form), and minimum thickness of wall noted.

(d) Render complete report (§ 178.51-21) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.51-5 Steel.

(a) Designations and limited chemical compositions of steels authorized by this specification shall be as shown in § 178.51-20, Table I.

§ 178.51-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with the heat number.

§ 178.51-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.51-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Exposed bottom welds on cylinders over 18 inches long must be protected by footrings. Seams must be made as follows: Minimum thickness of heads and bottoms shall be not less than 90 percent of the required thickness of the side wall.

(b) Circumferential seams. By welding or by brazing. Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swedged or curled over the skirt or flange of the head and must be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.

(c) Longitudinal seams in shells: By copper brazing, copper alloy brazing, or by silver alloy brazing. Copper alloy composition must be: Copper 95 percent minimum, Silicon 1.5 percent to 3.85 percent, Manganese 0.25 percent to 1.10 percent. The melting point of the silver alloy brazing material must be in excess of 1,000° F. The plate edge must be lapped at least eight times the thickness of plate, laps being held in position, substantially metal to metal, by riveting or by electric spot-welding. Brazing must be done by using a suitable flux and by placing brazing material on one side of seam and applying heat until this material shows uniformly along the seam of the other side.

(1) Strength of longitudinal seam: Copper brazed longitudinal seam must have strength at least 3/2 times the strength of the steel wall.

§ 178.51-9 Welding and brazing.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent except in the case of 4130X steel which may be used with proper welding procedure.

§ 178.51-10 Wall thickness.

(a) For outside diameters over 6″ the minimum wall thickness shall be 0.078″. In any case the minimum wall thickness shall be such that the calculated wall stress at minimum test pressure (§ 178.51-14) shall not exceed the lesser value of any of the following:

(1) The value shown in table I, § 178.51-20, for the particular material under consideration;

(2) One-half of the minimum tensile strength of the material determined as required in § 178.51-15;

(3) 35,000 pounds per square inch.

(4) Further provided that wall stress for cylinders having copper brazed longitudinal seams must not exceed 95 percent of any of the above values. Measured wall thickness shall not include galvanizing or other protective coating.

(b) Calculation must be made by the formula:

$$S = [P(1.3D^2 + 0.4d^2)]/(D^2 - d^2)$$

where:

S = wall stress in pounds per square inch;
P = minimum test pressure prescribed for water jacket test;
D = outside diameter in inches;
d = inside diameter in inches.

(c) Cylinders with wall thickness less than 0.100 inch, the ratio of tangential length to outside diameter shall not exceed 4.0.

§ 178.51-11 Heat treatment.

(a) Each cylinder must be uniformly and properly heat treated prior to test by the applicable method shown in § 178.51-20, Table I. Heat treatment must be accomplished after all forming and welding operations, except that when brazed joints are used, heat treatment must follow any forming and welding operations, but may be done before during or after the brazing operations.

(b) Heat treatment is not required after welding or brazing weldable low carbon parts to attachments of similar material which have been previously welded or brazed to the top or bottom of cylinders and properly heat treated, provided such subsequent welding or brazing does not produce a temperature in excess of 400° F. in any part of the top or bottom material.

§ 178.51-12 Openings in cylinders.

(a) All openings must be in the heads or bases.

(b) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing, by welding, or by threads. If threads are used they must comply with the following:

(1) Threads must be clean-cut, even, without checks and cut to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least, 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(c) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 178.51-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d), 173.124(a), and 173.301(g) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.51-14 Hydrostatic test.

(a) By water jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat treatment and previous to the official test must not exceed 90 percent of the test pressure.

(c) Permanent volumetric expansion must not exceed 10 percent of the total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) At least one cylinder selected at random out of each lot of 200 or less shall be tested as outlined in paragraphs (a), (b), and (c) of this section to at least two times service pressure.

(2) All cylinders not tested as outlined in paragraph (d)(1) of this section must be examined under pressure of at least two times service pressure and show no defect.

§ 178.51-15 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from one cylinder having passed the hydrostatic test, or part thereof heat-treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches, provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of the cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain reference shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.51-16 Elongation.

(a) Physical test specimens must show at least 40 percent for 2-inch gauge length or at least 20 percent in other cases, except that these elongation percentages may be reduced numerically by 2 for 2-inch specimens, and by 1 in other cases, for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four such increments.

§ 178.51-17 Tests of welds.

(Does not apply to brazed seams.)

(a) *Tests of welds. Tensile test.* A specimen shall be cut from one cylinder of each lot of 200 or less, or welded test plate.[1] The specimen must be

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[1] The welded test plate shall be of one of the heats in the lot of 200 or less which it represents, in the same condition and ap-

Continued

taken across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fail to meet the requirements, the entire lot represented shall be rejected.

(b) *Guided bend test.* A "root" bend test specimen shall be cut from the cylinder or welded test plate, used for the tensile test specified in paragraph (b) of this section. Specimens must be taken across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(c) *Alternate guided-bend test.* This test may be used and must be as required by CGA Pamphlet C-3. The specimen shall be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines a to b, shall be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in § 178.51-16(a).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18248, Nov. 14, 1969]

§ 178.51-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair of brazed seams by brazing and welded seams by welding is authorized.

§ 178.51-19 Marking.

(a) Marking on each cylinder stamped as follows:

(1) DOT-4BA followed by the service pressure (for example, DOT-4BA240, etc.).

(2) A serial number and an identifying symbol of the maker, except that numbers and symbols of user or purchaser are also authorized if the maker's symbol appears near the date of original test. Duplications unauthorized. Lot numbers in place of serial numbers authorized for cylinders not over 2 inches outside diameter or for cylinders with volumetric capacity not exceeding 60 cubic inches.

(3) Inspector's official mark.

(4) Date of test (such as 4-50 for April 50).

(5) Additional markings are permitted.

(b) Sequence of marks. Number shall be just below or immediately following the DOT mark; identifying symbol shall be just below or immediately following the number; inspector's official mark shall be near the serial number. Date of test shall be so placed that dates of subsequent test can easily be added. Symbol in front of or following the number, with space between, or symbol and serial number stamped into welded or brazed-on valve spud directly above the DOT mark located on head of cylinder are also authorized. Other variations in sequence of marks authorized only when necessitated by lack of space.

(c) Location of markings. Markings may be stamped plainly and permanently in the following locations on the cylinder:

(1) On shoulders and top heads not less than 0.087 inch thick.

(2) On side wall adjacent to top head for side walls not less than 0.090 inch thick.

(3) On neck, valve boss, valve protection sleeve, or similar part permanently attached to top end of cylinder.

(4) On a plate attached to the top of the cylinder or permanent part thereof; sufficient space must be left on the plate to provide for stamping at least six retest dates; the plate must be at least $\frac{1}{16}$ inch thick and must be attached by welding, or by brazing at a temperature of at least 1100° F., throughout all edges of the plate.

(5) On a cylindrical portion of the shell which extends beyond the recessed bottom of the cylinder constituting an integral and nonpressure part of the cylinder.

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proximately the same thickness as the cylinder wall except that in no case shall it be of lesser thickness than that required for a one-quarter size Charpy impact specimen. The weld must be made by the same procedures and subjected to the same heat treatment as the major weld on the cylinder.

(6) Variations in location of markings authorized only when necessitated by lack of space.

(d) *Size of marks.* Space permitting at least ¼ inch high.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5750, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.51-19 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.51-20 Authorized steel.

(a) As specified in Table I of Appendix A to this part.

[Amdt. 178-3, 34 FR 7163, May 1, 1969]

§ 178.51-21 Inspector's report.

(a) Required to be clear, legible and in following form:

(Place) ——————————————
(Date) ——————————————

Steel gas cylinders

Manufactured for ——————————————
Location at ——————————————
Manufactured by ——————————————
Location at ——————————————
Consigned to ——————————————
Location at ——————————————
Quantity —— Size —— inches outside diameter by —— inches long
Marks stamped into the ——————— (Location of marking) of the cylinder are:
Specification DOT ——————————
Serial numbers —— to —— inclusive.
Inspector's mark ——————————
Identifying symbol (registered) ——————
Test date ——————————————
Tare weights (yes or no) ———————
Other marks ——————————————

——————————————————————

——————————————————————

These cylinders were made by process of —

——————————————————————

The material used was type —— authorized in table I of Spec. No. 4BA.

The material used was identified by the following ——————— (heat-purchase order) ——————— numbers

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ————— (were—were not) marked on the material.

All material was inspected and all that was accepted was found free from seams, cracks, laminations and other injurious defects.

The compliance of cylinders with specification requirements was verified including markings, condition of inside, tests, threads, etc. All cylinders with defects which might prove injurious were rejected. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was —— inch. The outside diameter was determined by a close approximation to be —— inches. The wall stress was calculated to be —— pounds per square inch under an internal pressure of —— pounds per square inch.

Hydrostatic tests, tensile tests of material, and other tests as prescribed in specification No. DOT-4BA —— were made in the presence of the inspector and all cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

Each cylinder ——— (has-has not) been equipped with safety devices as follows: ——

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 4BA except as follows:

Exceptions ——————————————

——————————————————————

——————————————.

(Manufacturer's name)

Signed ——————————————
Inspector

By ———————————

(Place)..
(Date)..

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Numbered.. to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For.. Company

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis										
				C	P	S	Si	Mn	Ni	Cr	Mo	Cu	Al	Zr

Steel was manufactured by ———— Company. The originals of the certified mill test reports are in the files of the manufacturer.

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Chemical analyses were made by ....
(Place)..
(Date)..

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered........................ to .... inclusive
Size........................ inches outside diameter by........................ inches long
Made by .... Company
For.. Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per sq. inch)	Tensile strength (pounds per sq. inch)	Elongation (percent in inches)	Reduction of area (percent)	Weld tensile test	Weld bend test

(Signed)..
(Place)..
(Date)..

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered........................ to .... inclusive
Size........................ inches outside diameter by........................ inches long
Made by .... Company
For.. Company

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) [1]	Permanent expansion (cubic centimeters) [1]	Percent ratio of permanent expansion to total expansion [1]	Tare weight (pounds) [2]	Volumetric capacity [3]

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading. "Each cylinder was subjected to a pressure of ——— pounds per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

[3] Report approximate maximum and minimum volumetric capacity for the lot.

(Signed)..

§ 178.53 Specification 4D; inside containers, welded steel for aircraft use.

§ 178.53-1 Compliance.

(a) Required in all details.

§ 178.53-2 Type, size, and service pressure.

(a) *Type and size.* Welded steel spheres (two seamless hemispheres) or circumferentially welded cylinders (two seamless drawn shells) not over 100 pounds water capacity. Cylinders closed in by spinning process not authorized.

(b) *Service pressure.*[1] At least 300 to not over 500 pounds per square inch.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-46, 43 FR 17946, Apr. 27, 1978]

§ 178.53-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States and having a water capacity not exceeding 1,100 cubic inches, inspections may be performed by a competent inspector of the manufacturer. Chemical analyses and tests must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 178-46, 43 FR 17946, Apr. 27, 1978]

§ 178.53-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements; for cylinders made by billet-piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided,* That a certificate from the manufacturer thereof giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings, inspect inside before closing in both ends, verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.53-20) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.53-5 Steel.

(a) Open-hearth or electric steel of uniform and weldable quality. Content percent for the following not over: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050, except that the following steels commercially known as 4130X. Type 304, 316, 321, and 347 stainless steels may be used with proper welding procedure and complying with the following analyses.

4130X

	Percent
Carbon	0.25/0.35
Manganese	0.40/0.60
Phosphorus	0.04 max.
Sulfur	0.05 max.
Silicon	0.15/0.35
Chromium	0.80/1.10
Molybdenum	0.15/0.25
Zirconium	
Nickel	

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[1] The "service pressure" limits the use of the container. It is shown by marks on container; for example DOT-4C300 indicates the service pressure as 300 pounds per square inch.

	Stainless steels			
	304 (percent)	316 (percent)	321 (percent)	347 (percent)
Carbon (maximum)	0.08	0.08	0.08	0.08
Manganese (maximum)	2.00	2.00	2.00	2.00
Phosphorus (maximum)	.030	.045	.030	.030
Sulfur (maximum)	.030	.030	.030	.030
Silicon (maximum)	.75	1.00	.75	.75
Nickel	8.0/11.0	10.0/14.0	9.0/13.0	9.0/13.0
Chromium	18.0/20.0	16.0/18.0	17.0/20.0	17.0/20.0
Molybdenum		2.0/3.0		
Titanium			([1])	
Columbium				([2])

[1] Titanium shall be not less than 5×C and not more than 0.60 percent.

[2] Columbium shall be not less than 10×C and not more than 1.0 percent.

NOTE 1: A heat of steel made under the above specifications, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances shown in the following table are not exceeded, except as approved by the Department:

CHECK ANALYSIS TOLERANCES

Element	Limit or maximum specified (percent)	Tolerance (pct.) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Carbon	To 0.15 incl	0.01	0.01
	Over 0.15 to 0.40 incl	.03	.04
Manganese	To 0.60 incl	.03	.03
	Over 1.15 to 2.50 incl	.05	.05
Phosphorus[1]	All ranges		.01
Sulphur	......do		.01
Silicon	To 0.30 incl	.02	.03
	Over 0.30 to .00 incl	.05	.05
Nickel	Over 5.30 to 10.00 incl	.10	.10
	Over 10.00 to 14.00 incl	.15	.15
Chromium	To 0.90 incl	.03	.03
	Over 0.90 to 2.10 incl	.05	.05
	Over 15.00 to 20.00 incl	.20	.20
Molybdenum	To 0.20 incl	.01	.01
	Over 0.20 to 0.40 incl	.02	.02
	Over 1.75 to 3.00 incl	.10	.10
Titanium	All ranges	.05	.05
Colombium	......do	.05	.05

[1] Rephosphorized steels not subject to check analysis for phosphorus.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and paragraph (a) of App. A to Part 106)

[29 FR 18826, Dec. 29, 1964, as amended by Order 71, 31 FR 9076, July 1, 1966; 31 FR 9677, July 16, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt.178-55, 44 FR 21797, Apr. 12, 1979]

§ 178.53-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 178.53-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.53-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished container appreciably; reasonably smooth and uniform surface finish required.

§ 178.53-9 Wall thickness.

(a) The wall stress at minimum test pressure shall not exceed 24,000 pounds per square inch, except where steels commercially known as 4130X, types 304, 316, 321, and 347 stainless steels are used, stress at test pressures shall not exceed 37,000 pounds per square inch. Minimum wall for any container having a capacity of 1,100 cubic inches or less is 0.40 inch. Minimum wall for any container having a capacity in excess of 1,100 cubic inches is 0.095 inch.

(b) Calculation for a sphere must be made by the formula:

$$S=PD/4tE$$

where

S=wall stress in pounds per square inch;
P=test pressure prescribed for water jacket test, i.e., at least two times service pressure, in pounds per square inch;
D=outside diameter in inches;
t=minimum wall thickness in inches;
E=0.85 (provides 85 percent weld efficiency factor which must be applied in the girth weld area and heat affected zones which zone shall extend a distance of 6 times wall thickness from center line of weld);
E=1.0 (for all other areas).

(c) Calculation for a *cylinder* must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where

S=wall stress in pounds per square inch;
P=test pressure prescribed for water jacket test, i.e., at least two times service pressure, in pounds per square inch;
D=outside diameter in inches;
d=inside diameter in inches.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-46, 43 FR 17946, Apr. 27, 1978]

§ 178.53-10 Heat treatment.

(a) The completed cylinders must be uniformly and properly heat-treated prior to tests.

§ 178.53-11 Openings in container.

(a) Each opening in container, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to container by brazing or by welding or by threads. If threads are used, they must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the container; gaskets required, adequate to prevent leakage.

(b) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 178.53-12 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Devices must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d) and 173.301(g) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.53-13 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Containers must be tested as follows:

(1) Each container to at least 2 times service pressure, or

(2) One container out of each lot of 200 or less to at least 3 times service pressure. Others must be examined under pressure of 2 times service pressure and show no defects.

§ 178.53-14 Flattening test for spheres and cylinders.

(a) *Flattening test for spheres.* Between parallel steel plates on a press with welded seam at right angles to the plates; test one sphere taken at random out of each lot of 200 or less after hydrostatic test. Any projecting appurtenances may be cut off (by mechanical means only) prior to crushing.

(b) *Flattening test for cylinders.* Between knife edges, wedge shaped, 60° angle, rounded to ½ inch radius; test one cylinder [1] taken at random out of each lot of 200 or less, after hydrostatic test.

§ 178.53-15 Physical test and specimens for spheres and cylinders.

(a) *Physical test for spheres.* Required on 2 specimens cut from flat representative sample plate of the same heat taken at random from the steel used to produce the sphere. This flat steel from which the 2 specimens are to be cut must receive the same heat-treatment as the spheres themselves. Sample plates to be taken for each lot of 200 or less spheres.

(b) *Specimens for spheres.* Specimens must be gauge length 2 inches with width not over 1½ inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when wall of sphere is not over 3/16 inch thick.

(c) *Physical test for cylinders.* Required on 2 specimens cut from 1 [1] cylinder taken at random out of each lot of 200 or less.

(d) *Specimens for cylinders.* Specimens must be gauge length 8 inches with width not over 1½ inches; or gauge length 2 inches with width not over 1½ inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section. Heating of specimen for any purpose is not authorized.

(e) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.53-16 Acceptable results for physical and flattening tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

(b) Elongation at least 20 percent for 2 inch gauge length or 10 percent in other cases; flattening required to 50 percent of the original outside diameter without cracking.

§ 178.53-17 Rejected cylinders.

(a) Reheat-treatment authorized; subsequent thereto, acceptable containers must pass all prescribed tests. Repair of welded seam by welding prior to reheat-treatment authorized.

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[1] For lots of 30 or less, physical and flattening tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to the same heat-treatment as the finished cylinder.

§ 178.53-18 Marking.

(a) Marking on each container by stamping plainly and permanently only where the metal is at least 0.09 inch thick, or on a metal nameplate permanently secured to the container by means other than soft solder, or by means that would not reduce the wall thickness, as follows:

(1) DOT-4D followed by the service pressure (for example, DOT-4D300, etc.).

(2) A serial [1] number and an identifying symbol (letters); location [2] of number to be just below or immediately following the DOT mark; location [2] of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

DOT-4D300

1234

XY

DOT-4D300-1234-XY

(3) Inspector's official mark, near serial number; date of test (such as 8-50 for August 1950), so placed that dates of subsequent tests can be easily added.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by 30 FR 5750, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 42 FR 2689, Jan. 13, 1977]

§ 178.53-19 Size of marks.

(a) Of sufficient size to be legible.

§ 178.53-20 Inspector's report.

(a) Required to be clear, legible, and in the following form:

(Place) ————————————
(Date) ————————————
Gas ————————————
(spheres—cylinders)
Manufactured for ———————— Company
Location at ————————————
Manufactured by ———————— Company
Location at ————————————
Consigned to ———————— Company
Location at ————————————
Quantity————————————
Size ——— inches outside diameter by ——— inches long.
Marks stamped into the————————

————————————————
(Shoulder-metal plate, § 178.53-18)
Specification DOT- ————————
Serial numbers —— to ——, inclusive.
Inspector's mark ————————
Identifying symbol (registered)————
Test date ————————
Tare weights (yes or no) ————————
Other marks (if any) ————————

These containers were made by process of

————————————————

The material used was identified by the following ———————— (heat-purchase order) numbers ————————

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ————————(were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each container was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the container. The processes of manufacture and heat treatment of containers were supervised and found to be efficient and satisfactory.

The container walls were measured and the minimum thickness noted was ——— inch.

The outside diameter was determined by a close approximation to be ——— inches. The wall stress was calculated to be ——— pounds per square inch under an internal pressure of ——— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-4D were made in the presence of the inspector and all material and containers accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

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[1] Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches.

[2] Symbol in front of or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

I hereby certify that all of these containers proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 4D except as follows:

Exceptions: ______________________

____

____

____

Signed: ______________________
(Inspector)

(Place)..............................
(Date)..............................

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For.............................. Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Containers represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....
(Signed) ....
(Place)..............................
(Date) ....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For.............................. Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) ....
(Place)..............................
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CONTAINERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For.............................. Company

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) [1]	Permanent expansion (cubic centimeters) [1]	Percent ratio of permanent expansion to total expansion [1]	Tare weight (pounds) [2]	Volumetric capacity

NOTE: When specifications require test for only 1 out of each lot of 200 or less containers, the check on the other must be indicated by a notation hereon reading "Each container was subjected to a pressure of ——— pound per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the container by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include a removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) ....

§ 178.54 Specification 4B240-FLW; welded or welded and brazed cylinders with fusion-welded longitudinal seam.

§ 178.54-1 Compliance.

(a) Required in all details.

§ 178.54-2 Type, size, and service pressure.

(a) *Type and size.* Must be welded or brazed type with longitudinal fusion-welded seam. 240 pounds nominal water capacity. Cylinders closed in by spinning process not authorized.

(b) *Service pressure.*[1] 240 pounds per square inch.

§ 178.54-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976]

§ 178.54-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided,* That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.54-22) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.54-5 Steel.

(a) Steel shall be plain carbon steel of American Society for Testing Materials firebox quality with carbon content not in excess of 0.25 percent.

§ 178.54-6 Identification of material.

(a) Required; any suitable method.

§ 178.54-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.54-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Exposed bottom welds on cylinders over 18" long must be protected by footrings. Seams must be made as follows:

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[1] The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example, DOT-4B240-FLW.

(1) Circumferential seams by welding or by brazing: Heads attached by brazing must have a driving fit with the shell, unless the shell is crimped, swedged, or curled over the skirt or flange of the head, and be thoroughly brazed until complete penetration by the brazing material of the brazed joint is secured. Depth of brazing from end of shell must be at least four times the thickness of shell metal.

(2) Longitudinal fusion-welded seam shall be of the double-welded butt type. Filler metal may be added from one side when and if means are provided for accomplishing complete penetration and reinforcement on both sides of the joint. For welding the cylinder, procedure and operators must be qualified in accordance with the sections of CGA Pamphlet C-3 that apply.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.54-9 Welding or brazing.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent.

§ 178.54-10 Wall thickness.

(a) For outside diameters over 5 inches the minimum wall thickness shall be 0.090 inch. In any case the minimum wall thickness shall be such that calculated wall stress at 480 pounds per square inch shall not exceed 18,000 pounds per square inch.

(b) Calculation must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where

S=wall stress in pounds per square inch;
P=480 pounds per square inch;
D=outside diameter in inches;
d=inside diameter in inches.

§ 178.54-11 Heat treatment.

(a) Each cylinder shall be thermally stress-relieved after all initial welding and seam repair welding operations have been completed and prior to the hydrostatic test.

§ 178.54-12 Openings in cylinders.

(a) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing or by welding or by threads. Fitting, boss, or pad must be of steel suitable for the method of attachment employed, and which need not be identified or verified as to analysis, except that if attachment is by welding, carbon content must not exceed 0.25 percent. If threads are used they must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(b) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 178.54-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Devices must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d) and 173.301(g) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.54-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate date. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each cylinder shall be subjected to the hydrostatic test and test pressure shall be at least two and two thirds times the service pressure. Following this test, each cylinder shall be subjected to a dry air-pressure test of two times the service pressure. The cylinder shall be thoroughly dry before air test is applied, and during test welded seams shall be examined for leaks, either by submerging the cylinders in liquid, or by painting all welded seams with a solution suitable for the detection of leaks.

(e) One finished cylinder out of each lot, which appears to the inspector to be the least likely to meet the test, shall be selected by the inspector from each lot of 200 or less successively produced and shall be hydrostatically tested to destruction and shall not burst at a pressure less than six times the service pressure.

§ 178.54-15 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1[1] cylinder, or part thereof heat-treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

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[1] For lots of 30 or less, physical tests are authorized to be made on a ring at least 8 inches long cut from each cylinder and subjected to same heat treatment as the finished cylinder.

§ 178.54-16 Acceptable results for physical tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test not required.

§ 178.54-17 Weld tests.

(a) *Guided bend test.* A "root" bend test specimen shall be cut from the cylinder or welded test plate, used for the tensile test specified in § 178.54-15(a). Specimens must be taken across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(b) In addition to the guided bend test, a reduced section tension test shall be made transverse to the weld. The tensile strength shall be not less than 100 percent of the minimum of the specified tensile range of the base material used. Should this specimen fail to meet the requirements two additional specimens from the same cylinder shall be tested and if either of these fail to meet the requirements, the entire lot represented shall be rejected.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.54-18 Radiographic examination.

(a) The techniques and acceptability of radiographic inspection must conform to the standards set forth in CGA Pamphlet C-3.

(b) Cylinders must be examined as follows:

(1) One finished longitudinal seam shall be selected at random from each lot of 100 or less successively produced and be radiographed throughout its entire length. Should the radiographic examination fail to meet the requirements of paragraph (a) of this section, two additional seams of the same lot shall be examined, and if either of these fail to meet the requirements, each cylinder may be examined as outlined above; only those passing are acceptable.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.54-19 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto acceptable cylinders must pass all prescribed tests. Repair of brazed seams by brazing and welded seams by welding is authorized.

§ 178.54-20 Marking.

(a) Marking required on each cylinder by stamping plainly and permanently on shoulder, top head, or neck as follows:

(1) DOT-4B240-FLW.

(2) A serial number and an identifying symbol (letters); location[1] of number to be just below or immediately following the DOT mark; location[1] of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

Examples:

DOT-4B240-FLW
1234
XY

DOT-4B240-FLW-1234-XY

(3) Inspector's official mark near serial number, date of test (such as 12-50 for December 1950), so placed that dates of subsequent test can be easily added.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5751, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.54-20 see the List of CFR

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[1] Symbol in front of or following the number with ample space between or symbol and serial number stamped into welded or brazed-on valve spud directly above the DOT specification mark located on head of cylinder are also authorized. Other variations in location authorized only when necessitated by lack of space. (NOTE: Footnote 1 applies only to § 178.54-20. The Footnote 1 referenced in § 178.55-20 remains unchanged.)

Sections Affected appearing in the Finding Aids section of this volume.

§ 178.54-21 Size of marks.

(a) At least ¼" high if space permits.

§ 178.54-22 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) ——————————————
(Date) ——————————————
Gas cylinders
Manufactured for ———————— Company
Location at ——————————————
Manufactured by ———————— Company
Location at ——————————————
Consigned to ———————— Company
Location at ——————————————
Quantity ——————————————
Size —— inches outside diameter by ——inch long.
Marks stamped into the shoulder of the cylinder are:
Specification DOT- ————————
Serial numbers —— to —— inclusive
Inspector's mark ————————
Identifying symbol (registered) ————
Test date ————————
Tare weights (yes or no) ————————
Other marks (if any) ————————
These cylinders were made by process of
——————————————
——————————————
——————————————

The ———————— (neckrings, footrings, etc.) permitted in § 178.54-9 were attached by process of ———————— (welding—brazing)

This material was identified by the following ———————— (heat-purchase order) numbers ————————

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ———————— (were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was —— inch. The outside diameter was determined by a close approximation to be —— inches. The wall stress was calculated to be —— pounds per square inch under an internal pressure of —— pounds per square inch.

Hydrostatic tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-4B240FLW were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 4B240FLW except as follows:
Exceptions: ——————————————
——————————————

(Signed) ————————————
Inspector.

(Place)..............................
(Date)..............................

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered.............................. to .... inclusive
Size .... inches outside diameter by.............................. inches long
Made by .... Company
For.............................. Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file." or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....

(Signed) ....
(Place) ....
(Date) ....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)

(Signed) ....
(Place) ....
(Date) ....

RECORD OF WELD AND BURST TESTS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Cylinders represented by test (serial Nos.)	Root bend test acceptable (yes or no)	Transverse test acceptable (yes or no)	Radiographic examination acceptable (yes or no)	Burst test (pounds per square inch)

Radiographic technique employed consisted of ....

(Signed) ....
(Place) ....
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters)[1]	Permanent expansion (cubic centimeters)[1]	Percent ratio of permanent expansion to total expansion[1]	Tare weight (pounds)[2]	Volumetric capacity[3]

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

[3] Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) ....

§ 178.55 Specification 4B240ET; welded and brazed cylinders made from electric resistance welded tubing.

§ 178.55-1 Compliance.

(a) Required in all details.

§ 178.55-2 Type, spinning process, size and service pressure.

(a) *Type.* Cylinders must be of brazed type made from electric resistance welded tubing.

(b) *Spinning process.* Cylinders closed in by spinning process authorized.

(c) *Size.* The maximum water capacity of this type shall not exceed 12 pounds or 333 cubic inches. The maximum outside diameter of the shell shall be five inches and maximum length of shell 21 inches.

(d) *Service pressure.*[1] Must be 240 pounds per square inch.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-25, 37 FR 14588, July 21, 1972]

§ 178.55-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.55-4 Duties of inspector.

The inspector shall:

(a) Inspect all material and reject any not meeting the requirements.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided,* That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify heat treatment as proper; obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.55-22) to purchaser, cylinder maker, and the Associate Director for OE.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-25, 37 FR 14588, July 21, 1972]

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[1] The "service pressure" limits the use of the cylinder. It is shown by marks on cylinder; for example. DOT-4B240ET indicates the service pressure as 240 pounds per square inch.

§ 178.55-5 Steel.

(a) Open-hearth, basic oxygen, or electric steel of uniform quality. Plain carbon steel content percent for the following not over: Carbon, 0.25; phosphorus, 0.045; sulfur, 0.050. The addition of other elements for alloying effect is prohibited.

[Amdt. 178-3, 34 FR 7163, May 1, 1969]

§ 178.55-6 Identification of material.

(a) Required; any suitable method.

§ 178.55-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.55-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Heads may be attached to shells by lap brazing or may be formed integrally. The thickness of the bottom of cylinders welded or formed by spinning is, under no condition, to be less than two times the minimum wall thickness of the cylindrical shell; such bottom thicknesses to be measured within an area bounded by a line representing the points of contact between the cylinder and floor when the cylinder is in a vertical position. Seams must be made as follows:

(b) Circumferential seams: By brazing only. Heads attached to shells by the lap brazing method shall overlap not less than four times wall thickness. Brazing material shall have a melting point of not less than 1000° F. Heads must have a driving fit with the shell unless the shell is crimped, swedged, or curled over the skirt or flange of the head and be thoroughly brazed until complete penetration of the joint by the brazing material is secured. Brazed joints may be repaired by brazing.

(c) Longitudinal seams in shell: Electric resistance welded joints only. No repairs to longitudinal joints permitted.

§ 178.55-9 Welding or brazing.

(a) The attachment to the tops and bottoms only of cylinders by welding or brazing of neckrings, footrings, handles, bosses, pads, and valve protection rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent.

§ 178.55-10 Wall thickness.

(a) The wall stress at two times service pressure shall not exceed 18,000 pounds per square inch. Minimum thickness shall be 0.044 inch.

(b) Calculation must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where

S=wall stress in pounds per square inch;
P=2 times service pressure;
D=outside diameter in inches;
d=inside diameter in inches.

§ 178.55-11 Heat treatment.

(a) Heads formed by drawing or pressing must be uniformly and properly heat treated prior to tests.

(b) Cylinders with integral formed heads or bases must be subjected to a normalizing operation. Normalizing and brazing operations may be combined, provided the operation is carried out at a temperature in excess of the upper critical temperature of the steel.

§ 178.55-12 Openings in cylinders.

(a) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by brazing or by welding or by threads. Fitting, boss, or pad must be of steel suitable for the method of attachment employed, and which need not be identified or verified as to analysis, except that if attachment is by welding, carbon content must not exceed 0.25 percent. If threads are used, they must comply with the following:

(1) Threads must be clean cut, even without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(b) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 178.55-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Devices must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d) and 173.301(g) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.55-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal presure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) At least one cylinder selected at random out of each lot of 200 or less shall be tested as outlined in paragraphs (a), (b), and (c) of this section to at least two times service pressure.

(2) All cylinders not tested as outlined in paragraph (d)(1) of this section must be examined under pressure of at least two times service pressure and show no defect.

(e) Each 1000 cylinders or less successively produced each day shall constitute a lot. One cylinder shall be selected from each lot and hydrostatically tested to destruction. If this cylinder bursts below five times the service pressure, then two additional cylinders must be selected and subjected to this test. If either of these cylinders fails by bursting below five times the service pressure then the entire lot must be rejected. All cylinders constituting a lot shall be of identical size, construction heat-treatment, finish, and quality.

§ 178.55-15 Flattening test.

(a) Between knife edges, wedge shaped, 60° angle, rounded to ½" radius; test 1 cylinder taken at random out of each lot of 200 or less, after hydrostatic test.

§ 178.55-16 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from 1 cylinder, or part thereof heat-treated as required, taken at random out of each lot of 200 or less in the case of cylinders of capacity greater than 86 cubic inches and out of each lot of 500 or less for cylinders having a capacity of 86 cubic inches or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches; provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over ³⁄₁₆ inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.55-17 Acceptable results for physical and flattening tests.

(a) Elongation at least 40 percent for 2 inch gauge length or at least 20 percent in other cases; yield strength not over 73 percent of tensile strength; flattening test required, without cracking, to six times wall thickness with weld 90° from direction of applied load. Two rings cut from the ends of length of pipe used in production of a lot may be used for flattening test provided the rings accompany the lot which they represent in all thermal processing operations. At least one of the rings must pass the flattening test.

§ 178.55-18 Leakage test.

(a) All spun cylinders and plugged cylinders (see Notes 1 and 2) must be tested for leakage by gas or air pressure after the bottom has been cleaned and is free from all moisture. Pressure, approximately the same as but no less than service pressure, must be applied to one side of the finished bottom over an area of at least 1/16 of the total area of the bottom but not less than ¾" in diameter, including the closure, for at least 1 minute, during which time the other side of the bottom exposed to pressure must be covered with water and closely examined for indications of leakage. Leakers must be rejected. See § 178.55-19(a)(1).)

NOTE 1: A spun cylinder is one in which an end closure in the finished cylinder has been welded by the spinning process.

NOTE 2: A plugged cylinder is one in which a permanent closure in the bottom of a finished cylinder has been effected by a plug.

NOTE 3: As a safety precaution, if the manufacturer elects to make this test before the hydrostatic test, he should design his apparatus so that the pressure is applied to the smallest area practicable, around the point of closure, and so as to use the smallest possible volume of air or gas.

§ 178.55-19 Rejected cylinders.

(a) *Repairs authorized.* Leakers must be rejected, except that:

(1) Spun cylinders rejected under the provisions of § 178.55-18 may be removed from the spun cylinder category by drilling to remove defective material, tapping, and plugging.

(2) Brazed joints may be rebrazed.

(3) Subsequent to the operations noted above in paragraphs (a) (1) and (2) of this section, acceptable cylinders must pass all prescribed tests.

§ 178.55-20 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, neck or valve protection collar which is permanently attached to the cylinders and forming an integral part thereof, provided that cylinders not less and 0.090 inch thick may be stamped on the side wall adjacent to top head, as follows:

(1) DOT-4B240ET.

(2) A serial[1] number and an identifying symbol (letters); location[2] of number to be just below or immediately following the DOT mark; location[2] of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

Examples:

DOT-4B240ET

1234

XY

DOT-4B240ET-1234-XY

(3) Inspector's official mark, near serial number; date of test (such as 5-50 for May 1950), so placed that date of subsequent test can be easily added; and word "SPUN" or "PLUG" near DOT mark when an end closure in the finished cylinder has been welded by the spinning process or effected by plugging.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by 30 FR 5751, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 42 FR 2689, Jan. 13, 1977]

§ 178.55-21 Size of marks.

(a) At least ¼" high if space permits.

§ 178.55-22 Inspector's report.

(a) Required to be clear, legible, and in following form:

(Place) ——————————————
(Date) ——————————————
Gas cylinders

Manufactured for ———————— Company
Location at ——————————————
Manufactured by ———————— Company
Location at ——————————————
Consigned to ———————— Company
Location at ——————————————
Quantity——————————————
Size —— inches outside diameter by —— inches long.
Marks stamped into the shoulder of the cylinder are:
Specification DOT- ————————
Serial numbers —— to —— inclusive
Inspector's mark ————————
Identifying symbol (registered) ————
Test date ————————
Tare weights (yes or no) ————————
Other marks (if any) ————————

These cylinders were made by process of—

——————————————

——————————————

The ———————— (neckrings, footrings, etc.) permitted in § 178.55-9 were attached by process of ———————— (welding—brazing)

The material used was identified by the following ———————— (heat-purchase order) numbers ———

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ———————— (were—were not) marked on the material.

All material such as plates, billets and electric resistance welded tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was —— inch. The outside diameter was determined by a close approximation to be —— inches. The wall stress was calculated to be —— pounds per square inch under an internal pressure of —— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-4B-ET were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

A certificate of test on the electric resistance tubing has been obtained from the tubing manufacturer. Records thereof are attached hereto.

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[1] Lot numbers, not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 170 cubic inches.

[2] Symbol in front of or following the number with ample space between or symbol and serial number stamped into welded or brazed-on valve spud directly above the DOT specification mark located on head of cylinder are also authorized. Other variations in location authorized only when necessitated by lack of space.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. DOT-4B-ET except as follows:

Exceptions————————————

————————————

————————————

(Signed) ————————————
Inspector.

(Place)..........................
(Date)..........................

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered.......................... to .... inclusive
Size .... inches outside diameter by.......................... inches long
Made by .... Company
For.......................... Company

Test No.	Cylinders represented by test (serial nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test	Bursting test (pounds per square inch)

(Signed) ....
(Place)..........................
(Date) ....

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered.......................... to .... inclusive
Size .... inches outside diameter by.......................... inches long
Made by .... Company
For.......................... Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....
(Signed) ....
(Place)..........................
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered.......................... to .... inclusive
Size .... inches outside diameter by.......................... inches long
Made by .... Company
For.......................... Company

Serial numbers of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) [1]	Permanent expansion (cubic centimeters) [1]	Percent ratio of permanent expansion to total expansion [1]	Tare weight (pounds) [2]	Volumetric capacity [3]

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading. "Each cylinder was subjected to a pressure of —— pounds per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

[3] Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) ....

§ 178.56 Specification 4AA480; welded steel cylinders made of definitely prescribed steels.

§ 178.56-1 Compliance.

(a) Required in all details.

§ 178.56-2 Type, size, and service pressure.

(a) Must be welded type, having not over 1,000 pounds water capacity (nominal). Closures welded by spinning process not permitted.

(b) Service pressure 480 pounds per square inch.

§ 178.56-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufcturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associact Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.56-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements of this specification. For cylinders made by the billet piercing process, billets to be inspected after nick and cold break.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided,* That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with specification requirements including markings, condition of inside, tests, threads, heat treatment. Obtain samples for all tests; check chemical analyses; witness all tests; report volumetric capacity, tare weight (see report form) and minimum thickness of wall noted.

(d) Render complete report (§ 178.56-21) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.56-5 Steel.

(a) The limiting chemical composition of steel authorized by this specification shall be as shown in § 178.56-20, table I.

§ 178.56-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with the heat number.

§ 178.56-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.56-8 Manufacture.

(a) By best appliances and methods: dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. Exposed bottom welds on cylinders over 18 inches long must be protected by footrings. Minimum thickness of heads and bottoms shall be not less than 90 percent of the required thickness of the side wall. Seams must be made as follows:

(b) Circumferential seams: By welding. Brazing is not authorized.

(c) Longitudinal seams: Not permitted.

§ 178.56-9 Welding.

(a) The attachment to the tops and bottoms only of cylinders by welding of neckrings, footrings, bosses, pads, and valve protection rings is authorized provided that such attachments are made of weldable steel, the carbon content of which does not exceed 0.25 percent.

§ 178.56-10 Wall thickness.

(a) For outside diameters over 5 inches the minimum wall thickness shall be 0.078 inch. In any case the minimum wall thickness shall be such that the calculated wall stress at minimum test pressure (in § 178.56-14) shall not exceed the lesser value of either of the following:

(1) One-half of the minimum tensile strength of the material determined as required in § 178.56-15, or,

(2) 35,000 pounds per square inch.

(b) Calculation must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test;
D=outside diameter in inches;
d=inside diameter in inches.

(c) Cylinders with wall thickness less than 0.100 inch, the ratio of tangential length to outside diameter shall not exceed 4.0.

§ 178.56-11 Heat treatment.

(a) Each cylinder must be uniformly and properly heat treated prior to test. Any suitable heat treatment in excess of 1100° F., is authorized except that liquid quenching is not permitted. Heat treatment must be accomplished after all forming and welding operations.

(b) Heat treatment is not required after welding weldable low carbon parts to attachments of similar material which have been previously welded to the top or bottom of cylinders and properly heat treated, provided such subsequent welding does not produce a temperature in excess of 400° F., in any part of the top or bottom material.

§ 178.56-12 Openings in cylinders.

(a) All openings must be in the heads or bases.

(b) Each opening in cylinders, except those for safety devices, must be provided with a fitting boss, or pad, securely attached to cylinder by welding or by threads. If threads are used they must comply with the following:

(1) Threads must be clean-cut, even without checks and cut to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads having at least 6 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(c) Closure of fitting, boss or pad must be adequate to prevent leakage.

§ 178.56-13 Safety devices and protection for valves, safety devices, and other connections, if applied.

(a) Must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d), 173.124(a), and 173.301(g) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.56-14 Hydrostatic test.

(a) By water jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy of either 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for at least 30 seconds or sufficiently longer to assure complete expansion. Any internal pressure applied after heat-treatment and before the official test must not exceed 90 percent of the test pressure. If, due to failure of test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is lower.

(c) Permanent volumetric expansion must not exceed 10 percent of the total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) At least one cylinder selected at random out of each lot of 200 or less must be tested as described in paragraphs (a), (b), and (c) of this section, to at least two times service pressure. If a selected cylinder fails, then two additional specimens must be selected at random from the same lot and subjected to the prescribed test. If either of these fails the test, then each cylinder in that lot must be so tested; and

(2) Each cylinder not tested as prescribed in paragraph (d)(1) of this section must be examined under pressure of at least two times service pressure and must show no defect. A cylinder showing a defect must be rejected unless it may be requalified under § 178.56-18(a).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-25, 37 FR 14588, July 21, 1972]

§ 178.56-15 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from one cylinder having passed the hydrostatic test, or part thereof heat-treated as required, taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches, provided that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over $\frac{3}{16}$ inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain reference shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.56-16 Elongation.

(a) Physical test specimens must show at least 40 percent for 2-inch gauge length or at least 20 percent in other cases, except that these elongation percentages may be reduced numerically by 2 for 2-inch specimens and by 1 in other cases for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four such increments.

§ 178.56-17 Tests of welds.

(a) *Tensile test.* A specimen shall be cut from one cylinder of each lot of 200 or less, or welded test plate.[1] The specimens must be taken across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3. Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fail to meet the requirements, the entire lot represented shall be rejected.

(b) *Guided bend test.* A "root" bend test specimen shall be cut from the cylinder or welded test plate, used for the tensile test specified in paragraph (a) of this section. Specimens must be taken across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(c) *Alternate guided-bend test.* This test may be used and must be as required by CGA Pamphlet C-3. The specimen shall be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines—a to b, shall be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in § 178.56-16(a).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.56-18 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair of welded seams by welding is authorized.

§ 178.56-19 Marking.

(a) Marking on each cylinder stamped as follows:

(1) DOT-4AA480.

(2) A serial number and an identifying symbol of the maker, except that numbers and symbols of user or purchaser are also authorized if the maker's symbol appears near the date of original test. The symbol must be registered with the Associate Director for OE. Duplications unauthorized.

(3) Inspector's official mark.

(4) Date of test (such as 1-54 for January 1954).

(5) Additional markings are permitted.

(b) Sequence of marks. Number shall be just below or immediately following the DOT mark; identifying symbol shall be just below or immediately following the number; inspector's official mark shall be near the serial number. Date of test shall be so placed that dates of subsequent tests can easily be added. Symbol in front of the number, with space between, or symbol and serial number stamped into welded valve spud directly above the DOT mark located on head of cylinder are also authorized. Other variations in sequence of marks authorized only when necessitated by lack of space.

(c) Location of markings. Markings may be stamped plainly and permanently in the following locations on the cylinder:

---

[1] The welded test plate shall be of one of the heats in the lot of 200 or less which it represents, in the same condition and approximately the same thickness as the cylinder wall except that in no case shall it be of lesser thickness than that required for a one-quarter size Charpy impact specimen. The weld must be made by the same procedure and subjected to the same heat treatment as the major weld on the cylinder.

(1) On shoulders and top heads not less than 0.087 inch thick.

(2) On neck, valve boss, valve protection sleeve, or similar part permanently attached to top end of cylinder.

(3) On a plate attached to the top of the cylinder or permanent part thereof: sufficient space must be left on the plate to provide for stamping at least six retest dates: the plate must be at least 1/16 inch thick and must be attached by welding or by brazing at a temperature of at least 1.100° F., throughout all edges of the plate.

(4) Variations in location of markings authorized only when necessitated by lack of space.

(d) *Size of marks.* Space permitting, at least 1/4 inch high.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5751, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.56-19 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.56-20 Authorized steel.

(a) As specified in Table I of Appendix A to this part.

[Amdt. 178-3, 34 FR 7163, May 1, 1969]

§ 178.56-21 Inspector's report.

(a) Required to be clear, legible and in following form:

(Place) ————————————
(Date) ————————————
Steel gas cylinders
Manufactured for ————————————
Location at ————————————
Manufactured by ————————————
Location at ————————————
Consigned to ————————————
Location at ————————————
Quantity —— Size —— inches outside diameter by —— inches long.
Marks stamped into the ————————
(Location of marking) of the cylinder are:
Specification DOT- ————————————
Serial numbers —— to —— inclusive
Inspector's mark ————————————
Identifying symbol (registered) ————————
Test date ————————————
Tare weights (yes or no) ————————
Other marks ————————————
These cylinders were made by process of

————————————————————

The material used was type —— authorized in table I of Spec. No. 4AA480.

The material used was identified by the following ————————————(Heat-purchase order) numbers ————————.

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ———————————— (Were—were not) marked on the material.

All material was inspected and all that was accepted was found free from seams, cracks, laminations and other injurious defects.

The compliance of cylinders with specification requirements was verified including markings, condition of inside, tests, threads, etc. All cylinders with defects which might prove injurious were rejected. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was —— inch. The outside diameter was determined by a close approximation to be —— inches. The wall stress was calculated to be ——pounds per square inch under an internal pressure of —— pounds per square inch.

Hydrostatic tests, tensile tests of material, and other tests as prescribed in specification DOT-4AA480 were made in the presence of the inspector and all cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

Each cylinder ———————— (Has—has not) been equipped with safety devices as follows: ————————————

————————————————————

I hereby certify that all of those cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 4AA480 except as follows:

Exceptions ————————————
(Manufacturer's name)
————————————
Signed ————————————
(Inspector)
By ————————————

(Place)..
(Date)..

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Heat No.	Check analysis No.	Cylinders represented (Serial Nos.)	Chemical analysis										
				C	P	S	Si	Mn	Ni	Cr	Mo	Cu	Al	Zr

Steel was manufactured by ———— Company. The originals of the certified mill test reports are in the files of the manufacturer.

NOTE: Any omission of analyses by heats if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Chemical analyses were made by ....
(Place) ....
(Date) ....

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in inches)	Reduction of area (percent)	Weld tensile test	Weld bend test

(Signed) ....
(Place) ....
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters)	Permanent expansion (cubic centimeters) [1]	Percent ratio of permanent expansion to total expansion [1]	Tare weight (pounds) [2]	Volumetric capacity [3]

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of —— pounds per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

[3] Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) ....

§ 178.57 Specification 4L; welded cylinders insulated.

§ 178.57-1 Compliance.

(a) Required in all details.

§ 178.57-2 Type, size, service pressure,[1] and service temperature.[2]

(a) *Type and size.* Must be fusion welded; not over 1,000 pounds water capacity (nominal). For liquefied hydrogen service, the cylinders must be designed to stand on end, with the axis of the cylindrical portion vertical.

(b) The service pressure shall be more than 40 and not over 500 pounds per square inch.

(c) The service temperature shall be minus 320° F. or colder. For liquefied hydrogen service, the service temperature shall be minus 423° F. or colder.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-3, 34 FR 7163, May 1, 1969]

§ 178.57-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.57-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements of this specification.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided,* That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance with all specification requirements. Obtain samples for all tests. Obtain samples for check chemical analyses, where required. Witness all tests. Report volumetric capacity, tare weight (see report form), and minimum thickness of wall noted.

(d) Render complete report (§ 178.57-22) to purchaser, cylinder maker, and the Associate Director for OE.

§ 178.57-5 Material.

(a) Designations and limiting chemical compositions of steel authorized by this specification shall be as shown in § 178.57-21(a), Table I.

§ 178.57-6 Identification of material.

(a) Required; by any suitable method.

§ 178.57-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.57-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required. The shell portion must be a reasonably true cylinder.

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[1] The service pressure limits the use of the cylinder. It is shown by marks on the cylinder; for example: DOT-4L200 indicates the service pressure as 200 pounds per square inch.

[2] The service temperature is the lowest temperature at which the cylinder may be used.

(b) The heads must be seamless, concave side to the pressure, hemispherical or ellipsoidal in shape with the major diameter not more than twice the minor diameter. Minimum thickness of heads shall be not less than 90 percent of the required thickness of the sidewall. The heads must be reasonably true to shape, shall have no abrupt shape changes and the skirts must be reasonably true to round.

(c) The surface of the cylinder must be insulated. The insulating material must be fire resistant. The insulation must be covered with a steel jacket of not less than 0.060-inch thickness so constructed that moisture cannot come in contact with the insulating material. The construction must be such that the total heat transfer from the atmosphere at ambient temperature to the contents of the cylinder shall not exceed 0.0005 B.t.u. per hour per Fahrenheit degree differential in temperature per pound of water capacity of the cylinder. For liquefied hydrogen service, the total heat transfer, with a temperature difference of 520 Fahrenheit degrees, must not exceed that required to vent 30 standard cubic feet of hydrogen gas per hour.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-3, 34 FR 7163, May 1, 1969]

§ 178.57-9 Welding.

(a) All seams of the cylinder must be fusion welded. Means must be provided for accomplishing complete penetration of the joint. Only butt or joggle butt joints for the cylinder seams are authorized. All joints in the cylinder must be in reasonably true alignment.

(b) All attachments to the sidewalls and heads of the cylinder must be by fusion welding and must be of a weldable material complying with the impact requirements of § 178.57-17(d).

(c) For welding the cylinder, each procedure and operator must be qualified in accordance with the sections of CGA Pamphlet C-3 that apply. In addition, impact tests of the weld shall be performed in accordance with § 178.57-17(d) as part of the qualification of each welding procedure and operator.

(d) Brazing, soldering and threading are permitted only for joints not made directly to the cylinder body. Threads must comply with § 178.57-12.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.57-10 Wall thickness.

(a) The minimum wall thickness of the cylinder shall be such that the calculated wall stress at minimum required test pressure shall not exceed the least value of the following:

(1) 45,000 pounds per square inch.

(2) One-half of the minimum tensile strength across the welded seam determined as required in § 178.57-17(a).

(3) One-half of the minimum tensile strength of the base metal determined as required in § 178.57-15.

(4) The yield strength of the base metal determined as required in § 178.57-15.

(5) Further provided that wall for cylinders having longitudinal seams must not exceed 85 percent of the above value, whichever applies.

(b) Calculation must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where:

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for hydrostatic test;
D=outside diameter in inches;
d=inside diameter in inches.

§ 178.57-11 Heat treatment.

Not permitted.

[Amdt. 178-22, 36 FR 21289, Nov. 5, 1971]

§ 178.57-12 Openings in cylinder.

(a) Openings permitted in heads only. They must be circular and shall not exceed 3 inches diameter of ⅓ of the cylinder diameter, whichever is the smaller. Each opening in the cylinder must be provided with a fitting, boss or pad securely attached to the cylinder body by fusion welding. Attachments to a fitting, boss or pad may be made by welding, brazing, soldering or threading. Threads must comply with following:

(1) Threads must be clean cut, even, without checks and cut to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads must have at least 4 engaged threads and have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder gaskets required, inert to the commodity and adequate to prevent leakage.

§ 178.57-13 Safety devices and pressure control valves.

(a) Must be as required by Department of Transportation regulations that apply §§ 173.34(d), and 173.304(b)(2) of this chapter.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.57-14 Pressure test.

(a) Each cylinder before insulating and jacketing must be examined under a pressure of at least 2 times the service pressure maintained for at least 30 seconds without evidence of leakage, visible distortion or other defect. Pressure gauge must permit reading to accuracy of 1 percent.

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5751, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.57-15 Physical test.

(a) Determine yield strength, tensile strength, and elongation on 2 specimens selected from material of each heat and in the same condition as that in the completed cylinder.

(b) Specimens must be Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches; or gauge length at least 24 times thickness with width not over 6 times thickness (authorized when cylinder wall is not over 3/16 inch thick). The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within one inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic expansion of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on the elastic modulus of the material used. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain reference shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.57-16 Acceptable results for physical tests.

Physical properties must meet the limits specified in § 178.57-21(a), Table 1, for the particular steel in the annealed condition. The specimens must show at least 20 percent elongation for 2-inch gage length except that the percentage may be reduced numerically by 2 for each 7,500 pounds per square inch increment of tensile strength above 100,000 pounds per square inch to a maximum of 5 such increments. Yield strength and tensile strength must meet the requirements of § 178.57-21(a), Table 1.

[Amdt. 178-22, 36 FR 21289, Nov. 5, 1971]

§ 178.57-17 Tests of welds.

(a) *Tensile test.* A specimen shall be cut from one cylinder of each lot of 200 or less, or welded test plate.[1] The specimen must be taken across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3. Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fails to meet the requirements, the entire lot represented shall be rejected.

(b) *Guided bend test.* A "root" bend test specimen shall be cut from the cylinder or welded test plate, used for the tensile test specified in § 178.57-17(a) and from any other seam or equivalent welded test plate if the seam is welded by a procedure different from that used for the major seam. Specimens must be taken across the particular seam being tested and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(c) *Alternate guided-bend test.* This test may be used and must be as required by CGA Pamphlet C-3. The specimen shall be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines—a to b, shall be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 100,000 pounds per square inch, as provided in § 178.57-16(a).

(d) *Impact tests.* One set of three impact test specimens (for each test) shall be prepared and tested for determining the impact properties of the deposited weld metal (1) as part of the qualification of the welding procedure, (2) as part of the qualification of the operators, (3) for each "heat" of welding rod or wire used, and (4) for each 1,000 feet of weld made with the same heat of welding rod or wire.

(1) All impact test specimens shall be of the Charpy type, keyhole or milled U-notch, and shall conform in all respects to Figure 3 of ASTM E-23-60T. Each set of impact specimens shall be taken across the weld and have the notch located in the weld metal. When the cylinder material thickness is 2.5 mm or thicker, impact specimens shall be cut from a cylinder or welded test plate used for the tensile or bend test specimens. The dimension along the axis of the notch shall be reduced to the largest possible of 10 mm, 7.5 mm, 5 mm or 2.5 mm, depending upon cylinder thickness. When the material in the cylinder or welded test plate is not of sufficient thickness to prepare 2.5 mm impact test specimens, 2.5 mm specimens shall be prepared from a welded test plate made from ⅛ inch thick material meeting the requirements specified in § 178.57-21(a), Table 1, and having a carbon analysis of .05 minimum, but not necessarily from one of the heats used in the lot of cylinders. The test piece shall be welded by the same welding procedure as used on the particular cylinder seam being qualified and shall be subjected to the same heat treatment.

(2) Impact test specimens shall be cooled to the design service temperature. The apparatus for testing the specimens must conform to the requirements of ASTM Standard E-23-60T. The test piece, as well as the handling tongs, shall be cooled for a length of time sufficient to reach the service temperature. The temperature of the cooling device shall be main-

---

[1] The welded test plate shall be in the same condition and approximately the same thickness as the cylinder wall and shall be of material from one of the heats used in the lot of cylinders which it represents, except test plates for impact tests shall comply with § 178.57-17(d)(1). The test plate shall be welded by the same welding procedure as used on the particular cylinder seam being qualified and shall be subjected to the same heat treatment.

tained within a range of plus or minus 3° F. The specimen shall be quickly transferred from the cooling device to the anvil of the testing machine and broken within a time lapse of not more than six seconds.

(3) The impact properties of each set of impact specimens shall be not less than the values in the following table:

Size of specimen	Minimum impact value required for avg. of each set of three specimens (ft-lb)	Minimum impact value permitted on one specimen only of a set of three (ft-lb)
10 mm×10 mm	15	10
10 mm×7.5 mm	12.5	8.5
10 mm×5 mm	10	7.0
10 mm×2.5 mm	5	3.5

(4) When the average value of the three specimens equals or exceeds the minimum value permitted for a single specimen and the value for more than one specimen is below the required average value, or when the value for one specimen is below the minimum value permitted for a single specimen, a retest of three additional specimens shall be made. The value of each of these retest specimens shall equal or exceed the required average value. When an erratic result is caused by a defective specimen, or there is uncertainty in test procedure, a retest is authorized.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.57-18 Radiographic examination.

(a) The techniques and acceptability of radiographic inspection must conform to the standards set forth in CGA Pamphlet C-3.

(b) Cylinders must be examined as follows:

(1) One finished longitudinal seam shall be selected at random from each lot of 100 or less successively produced and be radiographed throughout its entire length. Should the radiographic examination fail to meet the requirements of paragraph (a) of this section, two additional seams of the same lot shall be examined, and if either of these fail to meet the requirements, each cylinder may be examined as outlined above, only those passing are acceptable.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.57-19 Rejected cylinders.

(a) Welds may be repaired by suitable methods of fusion welding; reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests.

§ 178.57-20 Marking.

(a) Marking required by stamping plainly and permanently on shoulder or top head of jacket or on a permanently attached plate or head protective ring as follows:

(1) DOT-4L followed by the service pressure (for example, DOT-4L200).

(2) ST followed by service temperature (for example, ST-423 F) on cylinders having a service temperature below minus 320° F. only; location to be just below the DOT mark.

(3) Serial number and identifying symbol; location of number to be just below or immediately following the service temperature or DOT mark; location of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

(4) Maximum weight of content (Max. Content 00 #) cylinders having a service temperature below minus 320° F. only; location near symbol.

Examples:

Service temperature minus 320° F.	Service temperature below minus 320° F.
DOT-4L200	DOT-4L200
1234	ST-423F
XY	1234
	XY
	MAX CONTENT 00 1

(5) Inspector's official mark, date of test (such as 10-55 for October 1955) near serial number.

(6) Size of markings at least ¼ inch high if space permits.

(b) Except for serial number, all markings prescribed in paragraph (a) of this section must be duplicated on each cylinder by any suitable means.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5751, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.57-20 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.57-21 Authorized steels.

(a) Electric furnace steel of uniform quality. Chemical analysis must conform to ASTM A-240, Type 304 Stainless Steel. The following chemical analyses and physical properties are authorized:

TABLE 1—AUTHORIZED MATERIALS

Designation	Chemical analysis, limits in percent, stainless steel; type 304
Carbon[1]	0.08 max.
Manganese	2.00 max.
Phosphorus	0.045 max.
Sulphur	0.030 max.
Silicon	1.00 max.
Nickel	8.00–10.50.
Chromium	18.00–20.00.
Molybdenum	
Titanium	
Columbium	
	Physical properties (annealed)
Tensile strength, p.s.i. (minimum)	75,000.
Yield strength, p.s.i. (minimum)	30,000.
Elongation in 2-inch (minimum) (percent)	30.0.
Elongation other permissible gage lengths (percent).	15.0.

[1] The carbon analysis must be reported to the nearest hundreds of 1 percent.

NOTE 1: A heat of steel made under the above specifications is acceptable, even though its check chemical analysis is slightly out of the specified range, if it is satisfactory in all other respects, provided the tolerances shown in the following table are not exceeded except as approved by the Department.

CHECK ANALYSIS TOLERANCES

Elements	Limit or max. of specified range, percent	Tolerance over the maximum limit or under the minimum limit
Carbon	To 0.030, inclusive	0.005
	Over 0.030 to 0.20, inclusive	0.01
Manganese	To 1.00, inclusive	0.03
	Over 1.00 to 3.00, inclusive	0.04
Phosphorus	To 0.040, inclusive	0.005
	Over 0.040 to 0.20, inclusive.	0.010
Sulfur	To 0.40, inclusive	0.005
Silicon	To 1.00, inclusive	0.05
Chromium	Over 15.00 to 20.00, inclusive	0.20
Nickel	Over 5.00 to 10.00, inclusive	0.10
	Over 10.00 to 20.00 inclusive	0.15

[1] Rephosphorized steels not subject to check analysis phosphorus.

[Amdt. 178-22, 36 FR 21289, Nov. 6, 1971]

§ 178.57-22 Inspector's report.

(a) Required to be clear, legible and in following form:

(Place) ————————————
(Date) ————————————
Steel gas cylinders
Manufactured for ————————————
Location at ————————————
Manufactured by ————————————
Location at ————————————
Consigned to ————————————
Location at ————————————
Quantity————————————
Size ———— inches outside diameter by ———— inches long
Cylinders were pressure tested at —— pounds per square inch and found to be satisfactory.
Maximum and minimum weight ——.
Maximum and minimum volumetric capacity ————————————
Marks stamped into the ———— (Location of marking) of the cylinder are:
Specification DOT- ————————————
Service Temperature — minus —° F.
Maximum Weight of Content — (pounds)
Serial numbers — to — inclusive
Inspector's mark ————————————
Identifying symbol (registered)————
Test date ————————————
Tare weights (yes or no) ————
Other marks————————————
These cylinders were made by process of—

————————————————————

The material used was authorized by § 178.57-21.

The material used was identified by the following ———————— (Heat-purchase order) numbers ————————

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ————————(were—were not) marked on the material.

All material was inspected and all that was accepted was found free from seams, cracks, laminations and other injurious defects.

The compliance of cylinders with specification requirements was verified including markings, condition of inside, tests, threads, etc. All cylinders with defects which might prove injurious were rejected. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

The cylinders walls were measured and the minimum thickness noted was —— inch. The outside diameter was determined by a close approximation to be —— inches. The wall stress was calculated to be —— pounds per square inch under an internal pressure of —— pounds per square inch.

Pressure tests, tensile tests of material, and other tests as prescribed in specification No. DOT-4L———————— were made in the presence of the inspector and all cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

Each cylinder ———————— (Has—has not) been equipped with safety devices as follows:

————————————————————

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 4L except as follows:

Exceptions————————————————

————————————————(Manufacturer's name)

By ————————————————

(Signed) ————————————————

(Inspector)

(Place) ————————————————

(Date) ————————————————

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Numbered —— to —— inclusive.

Size —— inches outside diameter by —— inches long.

Made by ———————— Company.

For ———————— Company.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis										
				C	P	S	Si	Mn	Ni	Cr	Mo	Cu	Al	Zr

Steel was manufactured by ——— Company. The originals of the certified mill test reports are in the files of the manufacturer.

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Chemical analyses were made by ————

(Place)................................

(Date)................................

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered................ to .... inclusive

Size................ inches outside diameter by................ inches long

Made by................ Company

For................ Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in inches)	Impact test results	Weld tensile test	Weld bend test

(Signed) ....

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5751, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.58 Specification 4DA; inside containers, welded steel for aircraft use.

§ 178.58-1 Compliance.

(a) Required in all details.

§ 178.58-2 Type, size, and service pressure.

(a) *Type and size.* Welded steel spheres (two seamless hemispheres) or circumferentially welded cylinders (two seamless drawn shells) not over 100 pounds water capacity.

(b) *Service pressure.*[1] At least 500 to not over 900 pounds per square inch.

§ 178.58-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976]

§ 178.58-4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements.

(b) Verify chemical analysis of each heat of material by analysis or by obtaining certified analysis: *Provided,* That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analyses of samples taken from one container out of each lot of 200 or less.

(c) Verify compliance of containers with all requirements including markings; inspect inside before closing; verify heat treatment and welding procedure as proper, obtain samples for all tests and check chemical analyses; witness all tests; verify threads by gauge; report volumetric capacity and tare weight and minimum thickness of wall noted.

(d) Render complete report to purchaser, container maker, and the Associate Director for OE.

§ 178.58-5 Steel.

(a) Open-hearth or electric steel of uniform quality. The following chemical analyses are authorized (see Note 1):

4130

	Percent
Carbon	0.28/0.33.
Manganese	0.40/0.60.
Phosphorus	0.040 max.
Sulfur	0.040 max.
Silicon	0.15/0.35.
Chromium	0.80/1.10.
Molybdenum	0.15/0.25.

NOTE 1: A heat of steel made under the above specifications, check chemical analysis of which is slightly out of the specified range, is acceptable, if satisfactory in all other respects, provided the tolerances shown in the following table are not exceeded except as approved by the Department:

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[1] The "service pressure" limits the use of the container. It is shown by marks on container; for example, DOT-4DA500 indicates the service pressure as 500 pounds per square inch.

CHECK ANALYSIS TOLERANCES

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Carbon	Over 0.15 to 0.40 incl	0.03	0.04
Manganese	To 0.60 incl	.03	.03
Phosphorus [1]	All ranges		.01
Sulphur	do		.01
Silicon	To 0.30 incl	.02	.03
	Over 0.30 to 1.00 incl	.05	.05
Chromium	To 0.90 incl	.03	.03
	Over 0.90 to 2.10 incl	.05	.05
Molybdenum	To 0.20 incl	.01	.01
	Over 0.20 to 0.40 incl	.02	.02

[1] Rephosphorized steels not subject to check analysis for phosphorus.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and paragraph (a) of App. A to Part 106)

[29 FR 18826, Dec. 29, 1964, as amended by Order 71, 31 FR 9077, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-55, 44 FR 21797, Apr. 12, 1979]

§ 178.58-6 Identification of material.

(a) Required; any suitable method except that plates and billets for hot-drawn containers shall be marked with heat number.

§ 178.58-7 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized. Defects in welded joints shall not exceed the limits specified in § 178.58-17 covering radiographic inspection.

§ 178.58-8 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished container appreciably, reasonably smooth and uniform surface finish required. No abrupt change in wall thickness permitted. Certification of welders; and/or process required in accordance with the sections of CGA Pamphlet C-3 that apply.

(b) All seams of the sphere or cylinders must be fusion welded. Seams shall be of the butt or joggle butt type and means must be provided for accomplishing complete penetration of the joint.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.58-9 Welding.

(a) Attachments to the container are authorized by fusion welding provided that such attachments are made of weldable steel, the carbon content of which must not exceed 0.25 percent except in the case of 4130 steel.

§ 178.58-10 Wall thickness.

(a) The minimum wall thickness shall be such that the wall stress at the minimum specified test pressure shall not exceed 67 percent of the minimum tensile strength of the steel as determined from the physical and burst tests required and shall not be over 70,000 p.s.i. Minimum wall 0.040 inch for any diameter container.

(b) Calculation for a sphere must be made by the formula:

$$S=PD/4tE$$

where:

S=wall stress in pounds per square inch;

P=test pressure prescribed for water jacket test, i.e., at least 2 times service pressure, in pounds per square inch;

D=outside diameter in inches;

t=minimum wall thickness in inches;

E=0.85 (provides 85 percent weld efficiency factor which must be applied in the girth weld area and heat affected zones which zone shall extend a distance of 6 times wall thickness from center line of weld);

$E = 1.0$ (for all other areas).

(c) Calculation for a cylinder must be made by the formula:

$$S = [P(1.3D^2 + 0.4d^2)]/(D^2 - d^2)$$

where:

S = wall stress in pounds per square inch;

P = test pressure prescribed for water jacket test, i.e., at least 2 times service pressure, in pounds per square inch;

D = outside diameter in inches;

d = inside diameter in inches.

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5751, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.58-11 Heat treatment.

(a) The completed containers must be uniformly and properly heat-treated prior to tests. Heat-treatment of containers of the authorized analysis shall be as follows:

(1) All containers must be quenched by oil, or other suitable medium except as provided in paragraph (a)(4) of this section.

(2) The steel temperature on quenching shall be that recommended for the steel analysis, but in no case shall exceed 1,750° F.

(3) The steel shall be tempered at the temperature most suitable for the analysis except that in no case shall the tempering temperature be less than 1,000° F.

(4) The steel may be normalized at a temperature of 1,650° F. instead of being quenched, and containers so normalized need not be tempered.

(5) [Reserved]

(6) All cylinders, if water quenched or quenched with a liquid producing a cooling rate in excess of 80 percent of the cooling rate of water, must be inspected by the magnetic particle or dye penetrant method to detect the presence of quenching cracks. Any cylinder found to have a quench crack must be rejected and may not be requalified.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-17, 36 FR 9521, May 26, 1971; Amdt. 178-25, 37 FR 14589, July 21, 1972]

§ 178.58-12 Openings in container.

(a) Each opening in the container must be provided with a fitting, boss, or pad of weldable steel securely attached to the container by fusion welding.

(b) Attachments to a fitting, boss, or pad must be adequate to prevent leakage. Threads must comply with the following:

(1) Threads must be clean cut, even, without checks, and tapped to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the container; gaskets required, adequate to prevent leakage.

§ 178.58-13 Safety devices.

(a) Safety relief devices must be as required by the Department of Transportation's Regulations. (See § 173.34(d) of this chapter).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.58-14 Hydrostatic test.

(a) By water-jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent or 100 pounds per square inch, whichever is the lower.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) Each container must be tested to at least 2 times service pressure.

§ 178.58-15 Burst test.

(a) One container taken at random out of 200 or less shall be hydrostatically tested to destruction. Rupture pressure shall be included as part of the inspector's report.

§ 178.58-16 Flattening test.

(a) *Flattening test for spheres.* At the weld between parallel steel plates on a press with welded seam at right angles to the plates, test one sphere taken at random out of each lot of 200 or less after hydrostatic test. Any projecting appurtenances may be cut off (by mechanical means only) prior to crushing.

(b) *Flattening test for cylinders.* Between knife edges, wedge shaped, 60° angle, rounded to ½ inch radius; test one cylinder taken at random out of each lot of 200 or less, after hydrostatic test.

§ 178.58-17 Radiographic inspection.

(a) Required on all welded joints which are subjected to internal pressure, except that at the discretion of the disinterested inspector, openings less than 25 percent of the sphere diameter need not be subjected to radiographic inspection. Evidence of any defects likely to seriously weaken the container shall be cause for rejection.

§ 178.58-18 Physical test and specimens for spheres and cylinders.

(a) *Physical test for spheres.* Required on 2 specimens cut from flat representative sample plate of the same heat taken at random from the steel used to produce the sphere. This flat steel from which the 2 specimens are to be cut must receive the same heat-treatment as the spheres themselves. Sample plates to be taken for each lot of 200 or less spheres.

(b) *Specimens for spheres.* Specimens must be gauge length 2 inches with width not over 1½ inches: *Provided,* That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when wall of sphere is not over 3/16 inch thick.

(c) *Physical test for cylinders.* Required on 2 specimens cut from 1 cylinder taken at random out of each lot of 200 or less.

(d) *Specimens for cylinders.* Specimens must be gauge length 8 inches with width not over 1½ inches; or gauge length 2 inches with width not over 1½ inches: *Provided,* That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section. Heating of specimen for any purpose is not authorized.

(e) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 percent offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.58-19 Acceptable results for physical, flattening, and burst tests.

(a) Elongation at least 20 percent for 2-inch gauge length or 10 percent in other cases.

(b) Flattening required to 50 percent of the original outside diameter without cracking.

(c) Burst pressure shall be at least 3 times service pressure.

§ 178.58-20 Rejected containers.

(a) Reheat-treatment authorized; subsequent thereto, acceptable containers must pass all prescribed tests. Repair of welded seams by welding prior to reheat-treatment authorized.

§ 178.58-21 Marking.

(a) Marking on each container by stamping plainly and permanently only on a permanent attachment or on a metal nameplate permanently secured to the container by means other than soft solder, as follows:

(1) DOT-4DA followed by the service pressure (for example, DOT-4DA900).

(2) A serial[1] number and an identifying symbol (letters); location[2] of number to be just below or immediately following the DOT mark; location[2] of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

Examples:

DOT-4DA900

1234

XY

DOT-4DA900-1234-XY

(3) Inspector's official mark, near serial number, date of test (such as 8-50 for August 1950), so placed that dates of subsequent tests can be easily added.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5751, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.58-21 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.58-22 Size of marks.

(a) Of sufficient size to be legible.

§ 178.58-23 Inspector's report.

(a) Required to be clear, legible, and in the following form:

(Place) ————————————
(Date) ————————————
Gas ————————————
(Spheres-cylinders)
Manufactured for ———— Company.
Location at ————————————
Manufactured by ———— Company.
Location at ————————————
Consigned to ———— Company.
Location at ————————————
Quantity————————————
Size —— inches outside diameter by —— inches long.
Marks stamped into the————————
(Shoulder-metal plate, § 178.58-21.)
Specification DOT- ————————
Serial numbers —— to —— inclusive.
Inspector's mark ————————
Identifying symbol (registered)————
Test date ————————
Tare weights (yes or no) ————
Other marks (if any) ————————
These containers were made by process of
————————————————

The material used was identified by the following ————————(Heat-purchase order) numbers ————————The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ——————(Were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each container was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the container. The processes of manufacture and heat treatment of containers were supervised and found to be efficient and satisfactory.

The container walls were measured and the minimum thickness noted was ——— inch. The outside diameter was determined by a close approximation to be ———inches. The wall stress was calculated to be ——— pounds per square inch under an internal pressure of ——— pounds per square inch.

---

[1] Lot numbers not over 500 cylinders in each lot, authorized for cylinders not over 2 inches outside diameter and for cylinders over 2 inches outside diameter when the volumetric capacity does not exceed 60 cubic inches.

[2] Symbol in front or following the number with ample space between is also authorized. Other variation in location authorized only when necessitated by lack of space.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-4DA were made in the presence of the inspector and all material and containers accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these containers proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 4DA except as follows:

Exceptions: ______________________
(Signed) ______________________
(Inspector)
(Place) ______________________
(Date) ______________________

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CONTAINERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

NOTE: Any omission of analyses by heats, if authorized must be accounted for by notation hereon reading, "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Containers represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....
(Signed) ....
(Place) ....
(Date) ....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CONTAINERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Containers represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed) ....
(Place) ....
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CONTAINERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Serial Nos. of containers tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters)[5]	Permanent expansion (cubic centimeters)[5]	Percent ratio of permanent expansion to total expansion[5]	Tare weight (pounds)[6]	Volumetric capacity

NOTE: When specifications require test for only 1 out of each lot of 200 or less containers, the check on the others must be indicated by a notation hereon reading. "Each container was subjected to a pressure of —— pounds per square inch and showed no defect."

[5] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[6] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

(Signed) ....

§ 178.59 Specification 8; steel cylinders with approved porous filling for acetylene.

§ 178.59-1 Compliance.

(a) Required in all details.

§ 178.59-2 Type and service pressure.

(a) *Type.* Seamless except that the following is authorized: Longitudinal seam if forge lap welded; attachment of heads by welding or by brazing by dipping process; welded circumferential body seam if cylinder has no longitudinal seam.

(b) *Service pressure.*[1] 250 pounds per square inch.

§ 178.59-3 Inspection by whom and where.

(a) Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(b) Duties of shell inspector:

(1) Inspect all material and reject any not complying with requirements; for cylinders made by billet piercing process, billets to be inspected after nick and cold break.

(2) Require certified chemical analyses of steel used, signed by manufacturer thereof; also verify by check analyses of samples taken from each heat or from 1 out of each lot of 200 or less plates, shells, or tubes used.

(3) Verify compliance of cylinder shells with all shell requirements; inspect inside before closing in both ends; verify heat treatment as proper; obtain all samples for all tests and for check analyses; witness all tests; verify threads by gauge; report volumetric capacity and minimum thickness of wall noted.

(4) Prepare report on manufacture of steel shells in form prescribed in § 178.59-20(a). Furnish one copy to manufacturer and three copies to the company that is to complete the cylinders.

(c) Duties of inspector of completed cylinders: Determine porosity of filling and tare weights; verify compliance of marking with prescribed requirements; obtain necessary copies of steel shell reports prescribed in paragraph (b) of this section; render complete reports, as prescribed in § 178.59-20 to the purchaser to the Associate Director for OE, and to the company that has completed the manufacture of the cylinders.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967 and amended by Amdt. 178-39, 41 FR 18416, May 4, 1976; Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

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[1] Service pressure limits the use of the cylinder to 250 pounds per square inch at 70° F.

§ 178.59-4 Steel.

(a) Open-hearth, electric or basic oxygen process steel of uniform quality. Content percent for the following not over: Carbon, 0.25; phosphorus, 0.045; sulphur, 0.050.

§ 178.59-5 Identification of steel.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 178.59-6 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.59-7 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required.

§ 178.59-8 Exposed bottom welds.

(a) Exposed bottom welds on cylinders over 18" long must be protected by footrings.

§ 178.59-9 Heat treatment.

(a) Body and heads formed by drawing or pressing must be uniformly and properly heat treated prior to tests.

§ 178.59-10 Openings.

(a) Standard taper pipe threads required; length not less than as specified for American Standard pipe threads; tapped to gauge; clean cut, even, and without checks.

§ 178.59-11 Safety devices and protection for valves, safety devices, and other connections.

(a) If applied must be as required by the Department of Transportation's regulations that apply. (See §§ 173.34(d) and 173.301(g) of this chapter.)

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.59-12 Hydrostatic test.

(a) By water jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) One cylinder out of each lot of 200 or less must be hydrostatically tested to at least 750 pounds per square inch. Cylinders not so tested must be examined under pressure of between 500 and 600 pounds per square inch and show no defect. If hydrostatically tested cylinder fails, each cylinder in the lot may be hydrostatically tested and those passing are acceptable.

§ 178.59-13 Leakage test.

(a) By interior air or gas pressure not less than the service pressure; leakers must be rejected. Required only for cylinders with bottoms closed in by spinning.

§ 178.59-14 Physical test.

(a) Required on 2 specimens cut longitudinally from 1 cylinder or part thereof taken at random out of each lot of 200 or less, after heat treatment.

(b) Specimens must be: Gauge length 8" with width not over 1½"; or gauge length 2" with width not over 1½": *Provided,* That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16" thick.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method

as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(d) Yield strength shall not exceed 73 percent of tensile strength. Elongation must be at least 40 percent in 2 inch or 20 percent in other cases.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.59-15 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding is authorized.

§ 178.59-16 Porous filling.

(a) Cylinders must be filled with a porous material in accordance with the following:

(1) The porous material may not disintegrate or sag when wet with solvent or when subjected to normal service;

(2) The porous filling material shall be uniform in quality and free of voids, except that a well drilled into the filling material beneath the valve is authorized if the well is filled with a material of such type that the functions of the filling material are not impaired;

(3) Overall shrinkage of the filling material is authorized if the total clearance between the cylinder shell and filling material, after solvent has been added, does not exceed ½ of 1 percent of the respective diameter or length, but not to exceed ⅛ inch, measured diametrically and longitudinally;

(4) The clearance may not impair the functions of the filling material;

(5) The installed filling material must meet the requirements of CGA Pamphlet C-12; and

(6) Porosity of filling material may not exceed 80 percent except that filling material with a porosity of up to 92 percent may be used when tested with satisfactory results in accordance with CGA Pamphlet C-12.

(b) When the porosity of each cylinder is not known, a cylinder taken at random from a lot of 200 or less must be tested for porosity. If the test cylinder fails, each cylinder in the lot may be tested individually and those cylinders that pass the test are acceptable.

(c) For filling that is molded and dried before insertion in cylinders, porosity test may be made on sample block taken at random from material to be used.

(d) The porosity of the filling material shall be determined; the amount of solvent at 70° F. for a cylinder:

(1) Having shell volumetric capacity above 20 pounds water capacity (nominal) shall not exceed the following:

Percent porosity of filler	Maximum acetone solvent percent shell capacity by volume
90 to 92	43.4
87 to 90	42.0
83 to 87	40.0
80 to 83	38.6
75 to 80	36.2
70 to 75	33.8
65 to 70	31.4

(2) Having volumetric capacity of 20 pounds or less water capacity (nominal), shall not exceed the following:

Percent porosity of filler	Maximum acetone solvent percent shell capacity by volume
90 to 92	41.8
83 to 90	38.5
80 to 83	37.1
75 to 80	34.8
70 to 75	32.5
65 to 70	30.2

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18823, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–66, 46 FR 22196, Apr. 16, 1981]

§ 178.59–17 Tare weight.

(a) Tare weight referred to in §§ 178.59–1 to 178.59–21 shall be the combined weight of cylinder proper, porous filling, valve, and solvent, but without removable cap.

§ 178.59–18 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on or near the shoulder, top head, neck or valve protection collar which is permanently attached to the cylinder and forming integral part thereof, as follows:

(1) DOT–8.

(2) A serial number and an identifying symbol (letters); grouped[1] above, below, or immediately following the DOT mark. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

Examples:

DOT–8

1234

XY

DOT–8–1234–XY

(3) Date of test (such as 5–50 for May 1950), so placed that dates of subsequent tests can be easily added.

(4) Tare weight of cylinder in pounds and ounces.

(5) Cylinders, not completed, when delivered must each be marked for identification of each lot of 200 or less.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5751, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.59–18 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.59–19 Size of marks.

(a) At least ⅛" high for cylinders less than 4" inside diameter and at least ¼" high for larger cylinders.

§ 178.59–20 Inspector's report.

(a) Report to cover manufacture of acetylene shells; require to be clear, legible, and in the following form:

(Place) ————————————
(Date) ————————————

Acetylene shells

Manufactured for ———————— Company
Location at ————————————
Manufactured by ———————— Company
Location at ————————————
Consigned to ———————— Company
Location at ————————————
Quantity ————————————
Size ——— inches outside diameter by ———— inches long.
Marks stamped into the shoulder of the cylinder are:
Lot number ————————————
Other marks (if any) ————————
These cylinders were made by process of—

————————————————————

————————————————————

The material used was identified by the following ———————— (heat-purchase order) numbers ————————

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ————————(were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

---

[1] Variation in location authorized only when necessitated by lack of space.

The cylinder walls were measured and the minimum thickness noted was —— inch. The outside diameter was determined by a close approximation to be —— inches. The wall stress was calculated to be —— pounds per square inch under an internal pressure of —— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-8 were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 8 except as follows:

Exceptions ————————————

————————————————

————————————————

(Signed) ————————————
Inspector

(Place)..................................
(Date)..................................

Record of Chemical Analysis of Material for Cylinders

Numbered.............................. to .... inclusive
Size.............................. inches outside diameter by.............................. inches long
Made by.............................. Company
For.............................. Company

Note: Any omission of analyses by heats, if authorized must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis						
				C	P	S	Si	Mn	Ni	Cr

The analyses were made by ....

(Signed)..................................
(Place)..................................
(Date)..................................

Record of Physical Tests of Material for Cylinders

Numbered.............................. to .... inclusive
Size.............................. inches outside diameter by.............................. inches long
Made by.............................. Company
For.............................. Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test

(Signed)..................................
(Place)..................................
(Date)..................................

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters)[1]	Permanent expansion (cubic centimeters)[1]	Percent ratio of permanent expansion to total expansion[1]	Volumetric capacity[2]

NOTE: When specification requires test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading. "Each cylinder was subjected to a pressure of pounds per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) ....

(b) Inspector's report to cover completed manufacture of acetylene cylinders; required to be clear and legible and in the following form:

(Place) —————————
(Date) —————————

Final Report: For completed steel cylinders with approved porous filling for acetylene.

Manufactured for —————————
Location at —————————
Steel shells manufactured by —————————
Location at —————————
Cylinders completed by —————————
Location at —————————
Consigned to —————————
Location at —————————
Quantity —————————
Size —— inches outside diameter by —— inches long.
Marks are stamped into —— (show location) as follows:
Specification DOT-8.
Serial numbers —— to —— inclusive.
Identifying symbol (registered) —————————
Inspector's mark (if applied) —————————
Test date —————————
Other marks (if any) —————————

—————————————————

Application of prescribed marks, as reported above, and location thereof were verified.

Each cylinder was filled with porous filling material consisting of —————————
In the form of —————————

The porosity of the filling is between —— and —— percent as determined by tests made by the ————————— company whose report has been found satisfactory and is on file.

The tare weight of each cylinder was determined and a record thereof is attached hereto.

Each cylinder has been equipped with safety devices —————————

—————————————————

A certified report of manufacture and test of the steel shells is attached hereto.

I hereby certify that, subject to the acceptability of the reports covering the steel shells, all of these cylinders proved satisfactory in every way and comply with the requirements of the Department of Transportation specification No. 8.

Signed —————————
(Inspector)

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-21, 36 FR 18469, Sept. 15, 1971]

§ 178.60 Specification 8AL; steel cylinders with approved porous filling for acetylene.

§ 178.60-1 Compliance.

(a) Required in all details.

§ 173.60-2 Type and service pressure.

(a) *Type*. Seamless except that the following is authorized: Attachment of heads by welding or by brazing by dipping process; welded circumferential body seam. Longitudinal seams not authorized.

(b) *Service pressure.* [1] 250 pounds per square inch.

§ 178.60-3 Inspection by whom and where.

(a) Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(b) Duties of shell inspector. Inspect all material and reject any not complying with requirements; for cylinders made by billet piercing process, billets to be inspected after nick and cold break.

(1) Require certified chemical analyses of steel used, signed by manufacturer thereof; also verify by check analyses of samples taken from each heat or from 1 out of each lot of 200 or less plates, shells, or tubes used.

(2) Verify compliance of cylinder shells with all shell requirements; inspect inside before closing in both ends; verify heat treatment as proper; obtain all samples for all tests and for check analyses; witness all tests; verify threads by gauge; report volumetric capacity and minimum thickness of wall noted.

(3) Report percentage of each specified alloying element in the steel. Prepare report on manufacture of steel shells in form prescribed in § 178.60-24(a). Furnish one copy to manufacturer and three copies to the company that is to complete the cylinders.

(c) Duties of inspector of completed cylinders. Determine porosity of filling and tare weights; verify compliance of marking with prescribed requirements; obtain necessary copies of steel shell reports prescribed in paragraph (b) of this section; render complete reports, as prescribed in § 178.60-24, to the purchaser, to the Associate Director for OE, and to the company that has completed the manufacture of the cylinders.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-39, 41 FR 18416, May 4, 1976; Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.60-4 Authorized steel.

(a) As specified in Table I of Appendix A to this part.

[Amdt. 178-3, 34 FR 7163, May 1, 1969]

§ 178.60-5 Identification of steel.

(a) Required; any suitable method except that plates and billets for hot-drawn cylinders shall be marked with heat number.

§ 178.60-6 Defects.

(a) Material with seams, cracks, laminations, or other injurious defects, not authorized.

§ 178.60-7 Manufacture.

(a) By best appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required.

§ 178.60-8 Footrings.

(a) Exposed bottom welds on cylinders over 18″ long must be protected by footrings.

§ 178.60-9 Welding or brazing.

(a) The attachment to the tops or bottoms only of cylinders by welding or brazing of neckrings, footrings, handlers, bosses, pads, and valve protecting rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent.

(b) Heat treatment is not required after welding or brazing weldable low carbon parts to attachments, specified in paragraph (a) of this section, of similar material which have been previously welded or brazed to the top or bottom of cylinders and properly heat treated, provided such subsequent welding or brazing does not produce a temperature in excess of 400° F. in any part of the top or bottom material.

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[1] Service pressure limits the use of the cylinder to 250 pounds per square inch at 70° F.

§ 178.60-10 Wall thickness; wall stress.

(a) The calculated wall stress at 750 pounds per square inch shall not exceed 35,000 pounds per square inch, or one-half of the minimum ultimate strength of the steel as determined in § 178.60-16, whichever value is the smaller. Measured wall thickness shall not include galvanizing or other protective coating.

(1) Calculation of wall stress must be made by the formula:

$$S = [P(1.3D^2 + 0.4d^2)] / (D^2 - d^2)$$

where

S=wall stress in pounds per square inch;
P=750 pounds per square inch (minimum test pressure);
D=outside diameter in inches;
d=inside diameter in inches.

Either D or d must be calculated from the relation $D = d + 2t$, where t = minimum wall thickness.

(2) Cylinders with wall thickness less than 0.100 inch, the ratio of straight side wall length to outside diameter shall not exceed 3.5.

(3) For cylinders having outside diameter over 5 inches, the minimum wall thickness shall be 0.087 inch.

§ 178.60-11 Heat treatment.

(a) Each cylinder must be uniformly and properly heat treated, prior to tests, by any suitable method in excess of 1100° F. Heat treatment must be accomplished after all forming and welding operations, except that when brazed joints are used, heat treatment must follow any forming and welding operations but may be done before, during, or after the brazing operations. Liquid quenching not authorized.

§ 178.60-12 Openings.

(a) Standard taper pipe threads required; length not less than as specified for American Standard pipe threads; tapped to gauge; clean cut, even, and without checks.

§ 178.60-13 Safety devices and protection for valves, safety devices, and other connections.

(a) If applied must be as required by the Department of Transportation regulations that apply. (See §§ 173.34(d) and 173.301(g) of this chapter.)

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-1, 33 FR 14934, Oct. 4, 1968]

§ 178.60-14 Hydrostatic test.

(a) By water jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat-treatment and previous to the official test must not exceed 90 percent of the test pressure.

(c) Permanent volumetric expansion must not exceed 10 percent of total volumetric expansion at test pressure.

(d) One cylinder out of each lot of 200 or less must be hydrostatically tested to at least 750 pounds per square inch. Cylinders not so tested must be examined under pressure of between 500 and 600 pounds per square inch and show no defect. If hydrostatically tested cylinder fails, each cylinder in the lot may be hydrostatically tested and those passing are acceptable.

§ 178.60-15 Leakage test.

(a) By interior air or gas pressure not less than the service pressure; leakers must be rejected. Required only for cylinders with bottoms closed in by spinning.

§ 178.60-16 Physical test.

(a) Required on 2 specimens cut longitudinally from 1 cylinder or part thereof taken at random out of each lot of 200 or less, after heat treatment.

(b) Specimens must be: Gauge length 8″ with width not over 1½″; or, gauge length 2″ with width not over 1½″: *Provided,* That gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16" thick.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "offset" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load") corresponding to the stress at which the 0.2 percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2 offset.

(3) For the purpose of strain measurement, the initial strain shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed 1/8 inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.60-17 Elongation.

(a) Physical test specimens must show at least 40 percent for 2 inch gauge length or at least 20 percent in other cases, except that these elongation percentages may be reduced numerically by 2 for 2 inch specimens and 1 in other cases for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four such increments.

§ 178.60-18 Weld tests.

(a) Specimens taken across the circumferentially welded seam must be cut from one cylinder taken at random from each lot of 200 or less cylinders after heat treatment and must pass satisfactorily the following tests:

(1) *Tensile test.* A specimen shall be cut from one cylinder of each lot of 200 or less, or welded test plate.[1] The specimen must be taken across the major seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3. Should this specimen fail to meet the requirements, specimens may be taken from two additional cylinders or welded test plates from the same lot and tested. If either of the latter specimens fail to meet the requirements, the entire lot represented shall be rejected.

(2) *Guided bend test.* A "root" bend test specimen shall be cut from the cylinder or welded test plate, used for the tensile test specified in paragraph (a)(1) of this section. Specimens must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(3) *Alternate guided-bend test.* This test may be used and must be as required by CGA Pamphlet C-3. The specimen shall be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gage lines—a to b, shall be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in § 178.60-17(a).

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

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[1] The welded test plate shall be of one of the heats in the lot of 200 or less which it represents, in the same condition and approximately the same thickness as the cylinder wall except that in no case shall it be of lesser thickness than that required for a one-quarter size Charpy impact specimen. The weld must be made by the same procedure and subjected to the same heat treatment as the major weld on the cylinder.

§ 178.60-19 Rejected cylinders.

(a) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair by welding is authorized.

§ 178.60-20 Porous filling.

(a) Cylinders must be filled with a porous material in accordance with the following:

(1) The porous material may not disintegrate or sag when wet with solvent or when subjected to normal service;

(2) The filling material shall be uniform in quality and free of voids, except that a well drilled into the filling material beneath the valve is authorized if the well is filled with a material of such type that the functions of the filling material are not impaired;

(3) Overall shrinkage of the filling material is authorized if the total clearance between the cylinder shell and filling material, after solvent has been added, does not exceed ½ of 1 percent of the respective diameter or length but not to exceed ⅛ inch, measured diametrically and longitudinally;

(4) The clearance may not impair the functions of the filling material;

(5) The installed filling material must meet the requirements of CGA Pamphlet C-12; and

(6) Porosity of filling material may not exceed 80 percent except that filling material with a porosity of up to 92 percent may be used when tested with satisfactory results in accordance with CGA Pamphlet C-12.

(b) When the porosity of each cylinder is not known, a cylinder taken at random from a lot of 200 or less must be tested for porosity. If the test cylinder fails, each cylinder in the lot may be tested individually and those cylinders that pass the test are acceptable.

(c) For filling that is molded and dried before insertion in cylinders, porosity test may be made on sample block taken at random from material to be used.

(d) The porosity of the filling material shall be determined; the amount of solvent at 70° F. for a cylinder:

(1) Having shell volumetric capacity above 20 pounds water capacity (nominal) shall not exceed the following:

Percent porosity of filler	Maximum acetone solvent percent shell capacity by volume
90 to 92	43.4
87 to 90	42.0
83 to 87	40.0
80 to 83	38.6
75 to 80	36.2
70 to 75	33.8
65 to 70	31.4

(2) Having volumetric capacity of 20 pounds or less water capacity (nominal), shall not exceed the following:

Percent porosity of filler	Maximum acetone solvent percent shell capacity by volume
90 to 92	41.8
83 to 90	38.5
80 to 83	37.1
75 to 80	34.8
70 to 75	32.5
65 to 70	30.2

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18823, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-65, 46 FR 22196, Apr. 16, 1981]

§ 178.60-21 Tare weight.

(a) Tare weight here referred to shall be the combined weight of cylinder proper, porous filling, valve, and solvent, but without removable cap.

§ 178.60-22 Marking.

(a) Marking on each cylinder as follows:

(1) DOT-8AL.

(2) A serial number and an identifying symbol (letters); grouped[1] above, below, or immediately following the DOT mark. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

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[1] Variation in location authorized only when necessitated by lack of space.

DOT-8AL

1234

XY

DOT-8AL-1234-XY

(3) Date of test (such as 5-50 for May 1950) so placed that dates of subsequent tests can be easily added.

(4) Tare weight of cylinder in pounds and ounces.

(5) Cylinders, not completed, when delivered must each be marked for identification of each lot of 200 or less.

(b) Markings shall be stamped plainly and permanently in locations in accordance with the following:

(1) On shoulders and top heads not less than 0.087 inch thick, or

(2) On neck, valve boss, valve protection sleeve, or similar part permanently attached to the top end of cylinder, or

(3) On a plate of ferrous material attached to the top of the cylinder or permanent part thereof; the plate must be at least 1/16 inch thick, and must be attached by welding, or by brazing at a temperature of at least 1,100° F. throughout all edges of the plate. Sufficient space must be left on the plate to provide for stamping at least four (4) retest dates.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5752, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.60–22 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.60–23 Size of marks.

(a) At least 1/8" high for cylinders less than 4" inside diameter and at least 1/4" high for larger cylinders.

§ 178.60–24 Inspector's report.

(a) Report to cover manufacture of acetylene shells; required to be clear, legible, and in the following form:

(Place) ————————
(Date) ————————

Acetylene shells

Manufactured for ———— Company
Location at ————————
Manufactured by ———— Company
Location at ————————
Consigned to ———— Company
Location at ————————
Quantity————————
Size —— inches outside diameter by —— inches long.
Marks stamped into the shoulder of the cylinder are:
Lot number ————————
Other marks (if any) ————————

These cylinders were made by process of

————————————

The ———————— permitted in (neckrings, footrings, etc.) § 178.60–9 were attached by process of ———————— (welding—brazing)

The material used was identified by the following ———— numbers —— (heat-purchase order)

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ————(were—were not) marked on the material.

All material, such as plates, billets and seamless tubing, was inspected and each cylinder was inspected both before and after closing in the ends; all that was accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment of cylinders were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was —— inch. The outside diameter was determined by a close approximation to be —— inches. The wall stress was calculated to be —— pounds per square inch under an internal pressure of —— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material, and other tests, as prescribed in specification No. DOT-8AL were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 8AL except as follows:

Exceptions: ————————

————————————

————————————

(Signed) ————————
Inspector
(Place) ————————
(Date) ————————

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis										
				C	P	S	Si	Mn	Ni	Cr	Mo	Cu	Al	Zr

Steel was manufactured by ———— Company.
The originals of the certified mill test reports are in the files of the manufacturer.

NOTE: Any omission of analysis by heats, if authorized, must be accounted for by notation hereon reading, "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

The analyses were made by ....
(Signed) ....
(Place) ....
(Date) ....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Cylinders represented by test (serial nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Weld tensile test	Weld bend test

(Signed) ....
(Place) ....
(Date) ....

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) [1]	Permanent expansion (cubic centimeters) [1]	Percent ratio of permanent expansion to total expansion [1]	Volumetric capacity [2]

NOTE: When specification requires test for only 1 out of each lot of 200 or less cylinders, the check on the other must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of —— pounds per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) ....

(b) Inspector's report to cover completed manufacture of acetylene cylinders; required to be clear and legible and in the following form:

(Place) ______________________
(Date) ______________________

Final Report: For completed steel cylinders with approved porous filling for acetylene.

Manufactured for ______________________
Location at ______________________
Steel sheets manufactured by __________
Location at ______________________
Cylinders completed by ______________
Location at ______________________
Consigned to ______________________
Location at ______________________
Quantity ______________________
Size —— inches outside diameter by —— inches long.
Marks are stamped into __________ (show location) as follows:
Specification DOT–8AL
Serial numbers —— to —— inclusive.
Identifying symbol (registered) __________
Inspector's mark (if applied) __________
Test date ______________________
Other marks (if any) ______________

Application of prescribed marks, as reported above, and location thereof were verified.

Each cylinder was filled with porous filling material consisting of ______________ in the form of ______________

The porosity of the filling is between —— and —— percent as determined by tests made by the ______________ company whose report has been found satisfactory and is on file.

The tare weight of each cylinder was determined and a record thereof is attached hereto.

Each cylinder has been equipped with safety devices ______________________

A certified report of manufacture and test of the steel shells is attached hereto.

I hereby certify that, subject to the acceptability of the reports covering the steel shells, all of these cylinders proved satisfactory in every way and comply with the requirements of the Department of Transportation specification No. 8AL.

Signed ______________________
(Inspector)

§ 178.61 Specification 4BW; welded steel cylinders made of definitely prescribed steels with electric-arc welded longitudinal seam.

[Order 71, 31 FR 9077, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61–1 Compliance.

(a) Required in all details.

[Order 71, 31 FR 9077, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61–2 Type, size and service pressure.

(a) Must be welded type with longitudinal electric-arc welded seam not over 1,000 pounds water, capacity (nominal); service pressure at least 225 and not over 500 pounds per square inch gauge. Cylinders closed in by spinning process not authorized.

[Order 71, 31 FR 9077, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61–3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)–(h))

[Amdt. 178–39, 41 FR 18415, May 4, 1976, as amended by Amdt. 178–64, 45 FR 81573, Dec. 11, 1980]

§ 178.61–4 Duties of inspector.

(a) Inspect all material and reject any not complying with requirements of this specification.

(b) Verify chemical analysis of each heat of materials by analysis or by obtaining certified analysis: *Provided*, That a certificate from the manufacturer thereof giving sufficient data to indicate compliance with requirements is acceptable when verified by check analyses of samples taken from one cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with specification requirements including: markings; condition of inside; tests; threads; heat treatment. Obtain samples for all tests, and check chemical analyses, witness all tests; report volumetric capacity, tare weight (see report form), and minimum thickness of wall noted.

(d) Render complete report (§ 178.61-21) to purchaser, cylinder maker, and the Associate Director for OE.

[Order 71, 31 FR 9077, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61-5 Authorized steel.

(a) As specified in Table I of Appendix A to this part.

(b) *Heads.* Material for heads shall be the same as paragraph (a) of this section or shall be open hearth, electric or basic oxygen carbon steel of uniform quality. Content percent for the following not over: Carbon 0.25, Manganese 0.60, Phosphorus 0.045, Sulfur 0.050.

(1) Heads shall be hemispherical or ellipsoidal in shape with a maximum ratio of 2.1. If low carbon steel is used thickness of such heads shall be determined by using a maximum wall stress of 24,000 p.s.i. in formula (§ 178.61-10(a)).

[Order 71, 31 FR 9078, July 1, 1966; 31 FR 9677, July 16, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-3, 34 FR 7163, May 1, 1969]

§ 178.61-6 Identification of material.

(a) Required; any suitable method.

[Order 71, 31 FR 9078, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61-7 Defects.

(a) Material with seams, cracks, laminations or other injurious defects, not authorized.

[Order 71, 31 FR 9078, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61-8 Manufacture.

(a) By suitable appliances and methods; dirt and scale to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface required. Exposed bottom welds on cylinders over 18 inches long must be protected by footrings. Minimum thickness of heads shall be not less than 90 percent of the required thickness of the sidewall. Heads shall be concave to pressure.

(b) *Circumferential seams.* By electric-arc welding. Joints shall be butt with one member offset (joggle butt) or lap with minimum overlap of at least four times nominal sheet thickness.

(c) *Longitudinal seams in shells.* (1) Longitudinal electric-arc welded seams shall be of the butt welded type. Welds must be made by a machine process including automatic feed and welding guidance mechanisms. Longitudinal seams shall have complete joint penetration, and shall be free from undercuts, overlaps or abrupt ridges or valleys. Misalignment of mating butt edges shall not exceed $1/6$ of nominal sheet thickness or $1/32$ inch whichever is less. All joints with nominal sheet thickness up to and including $1/8$ inch shall be tightly butted. When nominal sheet thickness is greater than $1/8$ inch, the joint shall be gapped with maximum distance equal to one-half the nominal sheet thickness or $1/32$ inch whichever is less. Joint design, preparation and fit-up shall be such that requirements of § 178.61-8(d) are satisfied.

(2) Maximum joint efficiency shall be 1.0 when each seam is radiographed completely. Maximum joint efficiency shall be 0.90 when one cylinder from each lot of 50 consecutively welded cylinders is sport radiographed. In addition, one out of the first five cylinders welded following a shut down of welding operations exceeding four hours shall be spot radiographed. Spot radiographs, when required, shall be made of a finished welded cylinder and shall include the girth weld for 2

inches in both directions from the intersection of the longitudinal and girth welds and include at least 6 inches of the longitudinal weld. Maximum joint efficacy of 0.75 shall be permissible without radiography.

(d) Welding procedure and operators must be qualified in accordance with the sections of CGA Pamphlet C-3 that apply.

[Order 71, 31 FR 9078, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1967]

§ 178.61-9 Welding of attachments.

(a) The attachment to the tops and bottoms only of cylinders by welding of neckrings, footrings, handles, bosses, pads and valve protection rings is authorized provided that such attachments and the portion of the container to which they are attached are made of weldable steel, the carbon content of which must not exceed 0.25 percent.

[Order 71, 31 FR 9078, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-14, 45 FR 13836, Sept. 1, 1970]

§ 178.61-10 Wall thickness.

(a) For outside diameters over 6 inches the minimum wall thickness shall be 0.078 inch. In any case the minimum wall thickness shall be such that the wall stress calculated by the formula (see Note 1):

$$S = [2P(1.3D^2 + 0.4d^2)] / [E(D^2 - d^2)]$$

shall not exceed the lesser value of any of the following:

(1) The value shown in Table I, § 178.61-5(a) for the particular material under consideration.

(2) One-half of the minimum tensile strength of the material determined as required in § 178.61-15.

(3) 35,000 pounds per square inch.

NOTE 1: In the formula above quoted

S=wall stress, p.s.i.;
P=service pressure, p.s.i.;
D=outside diameter, inches;
d=inside diameter, inches;
E=joint efficiency of the longitudinal seam (from § 178.61-8(c)(2)).

(b) In any cylinder with wall thickness less than 0.100 inch, the ratio of tangential length to outside diameter shall not exceed 4.0.

[Order 71, 31 FR 9079, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61-11 Heat treatment.

(a) Each cylinder must be uniformly and properly heat treated prior to test by the applicable method shown in § 178.61-5(a), Table I. Heat treatment must be accomplished after all forming and welding operations.

(b) Heat treatment is not required after welding or brazing weldable low carbon parts to attachments of similar material which have been previously welded to the top or bottom of cylinders and properly heat treated, provided such subsequent welding or brazing does not produce a temperature in excess of 400° F. in any part of the top or bottom material.

[Order 71, 31 FR 9079, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61-12 Openings in cylinders.

(a) All openings must be in the heads or bases.

(b) Openings in cylinders must be provided with adequate fittings, bosses, or pads, integral with or securely attached to the cylinder by welding.

(c) Threads must comply with the following:

(1) Threads must be clean cut and to gauge.

(2) Taper threads must be of length not less than as specified for American Standard Taper Pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(d) Closure of fittings, boss or pads must be adequate to prevent leakage.

[Order 71, 31 FR 9079, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61-13 Safety relief devices and protection for valves, safety devices and other connections, if applied.

(a) Must be as required by the Department of Transportation's Regulations that apply. (See §§ 173.34(d) and 173.301(g) of this chapter.)

§ 178.61-14 Hydrostatic test.

(a) By water jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit readings to accuracy of 1 percent. Expansion gauge must permit readings of total volumetric expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied after heat treatment and previous to the official test must not exceed 90 percent of the test pressure.

(c) Permanent volumetric expansion must not exceed 10 percent of the total volumetric expansion at test pressure.

(d) Cylinders must be tested as follows:

(1) At least 1 cylinder selected at random out of each lot of 200 or less shall be tested as outlined in paragraphs (a), (b), and (c) of this section to at least two times service pressure.

(2) All cylinders not tested as outlined in paragraph (d)(1) of this section must be examined under pressure of at least two times service pressure and show no defect.

(e) One finished cylinder selected at random out of each lot of 500 or less successively produced shall be hydrostatically tested to 4 times service pressure without bursting.

[Order 71, 31 FR 9079, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61-15 Physical test.

(a) To determine yield strength, tensile strength and elongation of material. Required on a specimen cut from each head and body section of a cylinder having passed the hydrostatic test.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or, gauge length 2 inches with width not over 1½ inches, provided, that gauge length at least 24 times thickness with width not over 6 times thickness is authorized when cylinder wall is not over 3/16 inch thick. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical tests detailed information in regard to such specimens. Heating of specimens for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by either the "off-set" method or the "extension under load" method as prescribed in ASTM Standard E8-78.

(2) In using the "extension under load" method, the total strain (or "extension under load"), corresponding to the stress at which the 0.2-percent permanent strain occurs may be determined with sufficient accuracy by calculating the elastic extension of the gauge length under appropriate load and adding thereto 0.2 percent of the gauge length. Elastic extension calculations shall be based on an elastic modulus of 30,000,000. In the event of controversy, the entire stress-strain diagram shall be plotted and the yield strength determined from the 0.2-percent offset.

(3) For the purpose of strain measurement, the initial strain reference shall be set while the specimen is under a stress of 12,000 pounds per square inch, the strain indicator reading being set at the calculated corresponding strain.

(4) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Order 71, 31 FR 9079, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.61-16 Elongation.

(a) Physical test specimens must show at least 40 percent for 2-inch gauge length or at least 20 percent in other cases, except that these elongation percentages may be reduced numerically by 2 for 2-inch specimens and by 1 in other cases for each 7,500 pounds per square inch increment of tensile strength above 50,000 pounds per square inch to a maximum of four increments.

[Order 71, 31 FR 9079, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61-17 Tests of welds.

(a) *Tensile test.* A specimen shall be cut from one cylinder of each lot of 200 or less. The specimen must be taken across the longitudinal seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(b) *Guided bend test.* A "root" test specimen shall be cut from the cylinder used for the tensile test specified in § 178.61-17(a). Specimens must be taken across the longitudinal seam and must be prepared and tested in accordance with and must meet the requirements of CGA Pamphlet C-3.

(c) *Alternate guided bend test.* This test may be used and must be as required by CGA Pamphlet C-3. The specimen shall be bent until the elongation at the outer surface, adjacent to the root of the weld, between the lightly scribed gauge lines a to b, shall be at least 20 percent, except that this percentage may be reduced for steels having a tensile strength in excess of 50,000 pounds per square inch, as provided in § 178.61-16(a).

[Order 71, 31 FR 9079, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.61-18 Radiographic examination.

(a) Radiographic inspection must conform to the techniques and acceptability criteria set forth in CGA Pamphlet C-3. When fluoroscopic inspection is used, permanent film records need not be retained.

(b) Should spot radiographic examination fail to meet the requirements of paragraph (a) of this section, two additional welds from the same lot of 50 cylinders or less shall be examined, and if either of these fail to meet the requirements, each cylinder shall be examined as previously outlined; only those passing are acceptable.

[Order 71, 31 FR 9079, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.61-19 Rejected cylinders.

(a) Unless otherwise stated, if a sample cylinder or specimen taken from a lot of cylinders fails the prescribed test, then two additional specimens must be selected from the same lot and subjected to the prescribed test. If either of these fail the test then the entire lot must be rejected.

(b) Reheat treatment authorized; subsequent thereto, acceptable cylinders must pass all prescribed tests. Repair of welded seams by welding is authorized provided that all defective metal be cut away and joint be rewelded as prescribed for original welded joints.

[Order 71, 31 FR 9079, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.61-20 Marking.

(a) Marking on each cylinder stamped as follows:

(1) DOT-4BW followed by the service pressure (for example, DOT-4BW240, etc.).

(2) A serial number and an identifying symbol of the maker, except that numbers and symbols of user or purchaser are also authorized if the maker's symbol appears near the date of original test. The symbol must be registered with the Associate Director for OE. Duplications unauthorized.

(3) Inspector's official mark.

(4) Date of test (for example, 12-64 for December 1964).

(5) Additional markings are permitted.

(b) *Sequence of marks.* DOT specification designation, registered symbol and serial number shall be in close proximity. Inspector's official mark shall be near the serial number. Date of test shall be so placed that dates of subsequent tests can easily be added.

(c) *Location of markings.* Markings may be stamped plainly and permanently in the following locations on the cylinder:

(1) On shoulders and top heads not less than 0.087-inch thick.

(2) On neck, valve boss, valve protection sleeve, or similar part permanently attached to top end of cylinder.

(3) On a plate attached to the top of the cylinder or permanent part thereof; sufficient space must be left on the plate to provide for stamping at least six retest dates; the plate must be at least 1/16-inch thick and must be attached by welding, or by brazing at a temperature of at least 1100° F. throughout all edges of the plate.

(4) Variations in location of markings when necessitated by lack of space permissible only when authorized by the Department.

(d) *Size of marks.* Space permitting, at least 1/4-inch high.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[Order 71, 31 FR 9079, July 1, 1966; 31 FR 9677, July 16, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 42 FR 2689, Jan. 13, 1977]

§ 178.61-21 Inspector's report.

(a) Required to be clear, legible and in following form:

(Place) ————————
(Date) ————————

Steel gas cylinders

Manufactured for ———— Company
Location at ————————
Manufactured by ———— Company
Location at ————————
Consigned to ———— Company
Location at ————————
Quantity————————
Size ———— inches outside diameter by ———— inches long
Marks stamped into the (location of marking) of the cylinder are:
Specification DOT- ————
Serial numbers —— to —— inclusive
Inspector's mark ————
Identifying symbol (registered) ————
Test date ————
Tare weights (yes or no) ————
Other marks————
————————
————————

These cylinders were made by process of ————————
————————

The material used was type ———— authorized in table I of Spec. No. 4BW.

The material used was identified by the following————————
————————
(heat-purchase order)
numbers ————————
————————

The material used was verified as to chemical analysis and record thereof is attached hereto. The heat numbers ————(were—were not) marked on the material.

All material was inspected and all that was accepted was found free from seams, cracks, laminations and other injurious defects.

Radiography ————————
(type and amount)

The compliance of cylinders with specification requirements was verified including markings, condition of inside, tests, threads, etc. All cylinders with defects which might prove injurious were rejected. The processes of manufacture and heat treatment were supervised and found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was —— inch. The outside diameter was determined to be ———— inches. The wall stress was calculated to be —— pounds per square inch.

Hydrostatic tests, tensile tests of material, and other tests as prescribed in specification No. DOT-4BW —— were made in the presence of the inspector and all cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

Each cylinder ———— (has—has not) been equipped with safety devices as follows: ————————
————————

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 4BW except as follows:

Exceptions————————
————————
————————
————————
————————

(Manufacturer's name)
(Signed) ————————
(Inspector)
By: ————————

(Place)...
(Date)...

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR CYLINDERS

Numbered... to .... inclusive
Size .... inches outside diameter by... inches long
Made by .... Company
For... Company

Test No.	Heat No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis										
				C	P	S	Si	Mn	Ni	Cr	Mo	Cu	Al	Zr

Steel was manufactured by......................Company.
The original of the certified mill test reports are in files of the manufacturer.

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Chemical analyses were made by...
(Place)...
(Date)...

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered... to .... inclusive
Size .... inches outside diameter by... inches long
Made by .... Company
For... Company

Test No.	Cylinders represented by test (serial Nos.)	Yield strength (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in inches)	Reduction of area (percent)	Weld tensile test	Weld bend test

(Signed) ....
(Place)...
(Date)...

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered... to .... inclusive
Size .... inches outside diameter by... inches long
Made by .... Company
For... Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters)[1]	Permanent expansion (cubic centimeters)[1]	Percent ratio of permanent expansion to total expansion[1]	Burst test (pounds per square inch)	Tare weight (pounds)[2]	Volumetric capacity

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters)[1]	Permanent expansion (cubic centimeters)[1]	Percent ratio of permanent expansion to total expansion[1]	Burst test (pounds per square inch)	Tare weight (pounds)[2]	Volumetric capacity

....

NOTE 1: When specifications require test for only one out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of pounds per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

[3] Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) ....

[Order 71, 31 FR 9080, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.65 Specification 39; non-reusable (non-refillable) cylinder.

[Amdt. 178-20, 36 FR 16580, Aug. 24, 1971]

§ 178.65-1 Compliance.

Each cylinder must meet the applicable requirements of § 173.24 of this chapter.

[Amdt. 178-20, 36 FR 16580, Aug. 24, 1971]

§ 178.65-2 Type, size, service pressure, and test pressure.

(a) Type: Each cylinder must be of seamless, welded, or brazed construction. Spherical pressure vessels are authorized and covered by references to cylinders in this specification.

(b) Size limitation: Maximum water capacity may not exceed:

(1) 55 pounds (1,526 cubic inches) for a service pressure of 500 p.s.i.g. or less, and

(2) 10 pounds (277 cubic inches) for a service pressure in excess of 500 p.s.i.g.

(c) Service pressure: The marked service pressure may not exceed 80 percent of the test pressure.

(d) Test pressure: The minimum test pressure is the maximum pressure of contents at 130° F. or 180 p.s.i.g. whichever is greater.

(e) The term "pressure of contents" as used in this specification means the total pressure of all the materials to be shipped in the cylinder.

[Amdt. 178-20, 36 FR 16851, Aug. 24, 1971]

§ 178.65-3 Inspection by whom and where.

(a) In the case of cylinders having marked service pressures higher than 900 p.s.i.g., inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter.

(b) In the case of cylinders having marked service pressures of 900 p.s.i.g. or lower, inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, by a competent inspector of the manufacturer.

(c) Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18416, May 4, 1976]

§ 178.65-4 Duties of inspector.

(a) The inspector must determine that all material used complies with the requirements of this specification.

(b) The inspector must verify compliance with the requirements of § 178.65-5 by making a chemical analysis or obtaining a certified chemical analysis from the material manufacturer for each heat of material (ladle analysis acceptable). If an analysis is not provided by the material manufacturer, a sample from each coil, sheet, or tube must be analyzed.

(c) The inspector must determine that each cylinder is made and marked in compliance with this specification by:

(1) Complete internal and external inspection (interested inspectors authorized);

(2) Verification of proper heat treatment (if any);

(3) Selection of samples to be tested;

(4) Witnessing all tests; and

(5) By preparation of required report.

[Amdt. 178-20, 36 FR 16581, Aug. 24, 1971]

§ 178.65-5 Material; steel or aluminum.

(a) Steel:

(1) The steel analysis must conform to the following:

	Ladle analysis	Check analysis
Carbon, maximum percent	0.12	0.15
Phosphorus, maximum percent	0.04	0.05
Sulfur, maximum percent	0.05	0.06

(2) For a cylinder made of seamless steel tubing with integrally formed ends, hot drawn, and finished, content percent for the following must not exceed: Carbon, 0.55; phosphorous, 0.045; sulfur, 0.050.

(3) For non-heat treated welded steel cylinders, adequately killed deep drawing quality steel is required.

(4) Longitudinal or helical welded cylinders are not authorized for service pressures in excess of 500 p.s.i.g.

(b) Aluminum: Aluminum not authorized for service pressures in excess of 500 p.s.i.g. Analysis of aluminum must conform to Aluminum Association standard designated for alloys 1100, 1170, 3003, 5052, 5086, 5154, 6061, and 6063 specified in its publication entitled "Aluminum Standards and Data" (1970-71 edition dated December 1969).

(c) Material with seams, cracks, laminations, or other injurious defects not permitted.

(d) Material used must be identified by any suitable method.

[Amdt. 178-20, 36 FR 16581, Aug. 24, 1971]

§ 178.65-6 Manufacture.

(a) General manufacturing requirements are as follows:

(1) Dirt and scale must be removed prior to inspection and processing.

(2) The surface finish must be uniform and reasonably smooth.

(3) Inside surfaces must be clean, dry, and free of loose particles.

(4) No defect of any kind is permitted if it is likely to weaken a finished cylinder.

(b) Requirements for seams:

(1) Brazing is not authorized on aluminum cylinders.

(2) Brazing material must have a melting point of not lower than 1,000° F.

(3) Brazed seams must be assembled with proper fit to insure complete penetration of the brazing material throughout the brazed joint.

(4) Minimum width of brazed joints must be at least four times the thickness of the shell wall.

(5) Brazed seams must have design strength equal to or greater than 1.5 times the minimum strength of the shell wall.

(6) Welded seams must be properly aligned and welded by a method that provides clean, uniform joints with adequate penetration.

(7) Welded joints must have strength equal to or greater than the minimum strength of the shell material in the finished cylinder.

(c) Attachments to the cylinder are permitted by any means which will not be detrimental to the integrity of the cylinder. Welding or brazing of attachments to the cylinder must be completed prior to all pressure tests.

[Amdt. 178-20, 36 FR 16582, Aug. 24, 1971]

§ 178.65-7 Wall thickness.

(a) The minimum wall thickness must be such that the wall stress at test pressure does not exceed the yield strength of the material of the finished cylinder wall.

(b) Calculation of the stress for cylinders must be made by the formula

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where:

S=Wall stress, in p.s.i.;
P=Test pressure;
D=Outside diameter, in inches;
d=Inside diameter, in inches.

(c) Calculation of the stress for spheres must be made by the formula:

$$S=PD/4t$$

where:

S=Wall stress, in p.s.i.;
P=Test pressure;
D=Outside diameter, in inches;
t=Minimum wall thickness, in inches.

[Amdt. 178-20, 36 FR 16582, Aug. 24, 1971]

§ 178.65-9 Openings and attachments.

(a) Openings and attachments are permitted on heads only.

(b) All openings and their reinforcements must be within an imaginary circle, concentric to the axis of the cylinder. The diameter of the circle may not exceed 80 percent of the outside diameter of the cylinder. The plane of the circle must be parallel to the plane of a circumferential weld and normal to the long axis of the cylinder.

(c) Unless a head has adequate thickness, each opening must be reinforced by a securely attached fitting, boss, pad, collar, or other suitable means.

(d) Material used for welded openings and attachments must be of weldable quality and compatible with the material of the cylinder.

[Amdt. 178-20, 36 FR 16582, Aug. 24, 1971]

§ 178.65-10 Safety devices.

Safety devices must meet the requirements of § 173.34(d) of this chapter.

[Amdt. 178-20, 36 FR 16582, Aug. 24, 1971]

§ 178.65-11 Pressure tests.

(a) Each cylinder must be tested at an internal pressure of at least the test pressure and must be held at that pressure for at least 30 seconds.

(1) The leakage test must be conducted by submersion under water or by some other method that will be equally sensitive.

(2) If the cylinder leaks, evidences visible distortion, or any other defect, while under test, it must be rejected (see § 178.65-13).

(b) One cylinder taken from the beginning of each lot, and one from each 1,000 or less successively produced within the lot thereafter, must be hydrostatically tested to destruction. The entire lot must be rejected if (see § 178.65-13):

(1) A failure occurs at a gage pressure less than 2.0 times the test pressure.

(2) A failure initiates in a braze or a weld or the heat affected zone thereof;

(3) A failure is other than in the sidewall of a cylinder longitudinal with its long axis, or

(4) In a sphere, a failure occurs in any opening, reinforcement, or at a point of attachment.

(c) A "lot" is defined as the quantity of cylinders successively produced per production shift (not exceeding 10 hours) having identical size, design, construction, material, heat treatment, finish, and quality.

[Amdt. 178-20, 36 FR 16582, Aug. 24, 1971; 36 FR 17343, Aug. 28, 1971]

§ 178.65-12 Flattening test.

(a) One cylinder must be taken from the beginning of production of each lot (as defined above) and subjected to a flattening test.

(1) The flattening test must be made on a cylinder that has been tested at test pressure.

(2) A ring taken from a cylinder may be flattened as an alternative to a test on a complete cylinder. The test ring must not include the heat affected zone or any weld. However, for a sphere, the test ring may include the circumferential weld if it is located at a 45 degree angle to the ring, ±5 degrees.

(3) The flattening must be between 60 degrees included-angle, wedge shaped knife edges, rounded to a 0.5 inch radius.

(4) Cylinders and test rings must not crack when flattened so that their outer surfaces are not more than six times wall thickness apart when made of steel or not more than ten times wall thickness apart when made of aluminum.

(b) If any cylinder or ring cracks when subjected to the specified flattening test, the lot of cylinders represented by the test must be rejected (see § 178.65-13).

[Amdt. 178-20, 36 FR 16582, Aug. 24, 1971]

§ 178.65-13 Rejected cylinders.

(a) If the cause for rejection of a lot is determinable, and if by test or inspection defective cylinders are eliminated from the lot, the remaining cylinders must be qualified as a new lot under §§ 178.65-11 and 178.65-12.

(b) Repairs to welds are permitted. Following repair, a cylinder must pass the pressure test specified in § 178.65-11(a).

(c) If a cylinder made from seamless steel tubing fails the flattening test described in § 178.65-12, suitable uniform heat treatment must be used on each cylinder in the lot. All prescribed tests must be performed subsequent to this heat treatment.

[Amdt. 178-20, 36 FR 16582, Aug. 24, 1971]

§ 178.65-14 Markings.

(a) The markings required by this section must be durable and waterproof. The requirements of § 173.24 (c)(1) (ii) and (iv) of this chapter do not apply to this section.

(b) Required markings are as follow:

(1) DOT-39.

(2) NRC.

(3) The service pressure.

(4) The test pressure.

(5) The registration number (M****) of the manufacturer.

(6) The lot number.

(7) The date of manufacture if the lot number does not establish the date of manufacture.

(8) The following statement: Federal law forbids transportation if refilled—penalty up to $25,000 fine and 5 years imprisonment (49 U.S.C. 1809).

NOTE: Preprinted labels complying with 49 CFR 178.65-14(b)(8) in effect January 2, 1977, may be used until January 3, 1978.

(c) The markings required by paragraphs (b) (1) through (5) of this section must be in numbers and letters at least ⅛ inch high and displayed sequentially. For example:

DOT-39 NRC 250/500 M1001.

(d) No person may mark any cylinder with the specification identification "DOT-39" unless (1) it was manufactured in compliance with the requirements of this section and (2) its manufacturer has a registration number (M****) from the Office of Operations and Enforcement, Materials Transportation Bureau, Department of Transportation, Washington, D.C. 20590.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[Amdt. 178-20, 36 FR 16582, Aug. 24, 1971; 36 FR 17343, Aug. 28, 1971, as amended by Amdt. 178-40, 42 FR 2689, Jan. 13, 1977; Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.65-15 Inspector's report.

(a) The inspector's report must be retained by the manufacturer for a period of 3 years and must be available for examination by representatives of the Department.

(b) The report must be legible, and contain at least the following information:

INSPECTION REPORT COVERING THE MANUFACTURE OF SPECIFICATION DOT-39 CYLINDERS OR SPHERES

The cylinders (spheres) covered by this report were manufactured for ——————
located at ——————————. They were
manufactured by ——————————————
located at ——————————————————
whose Department of Transportation registration number is M———. The cylinders are ——— inches in diameter (OD) and ——— inches in length. They have a design test pressure of ——— p.s.i.g. and a marked service pressure of —— p.s.i.g. Each has an internal volume of ——— cubic inches (nominal).

These containers were made by process of ————————.

The metal used was identified by heat or analysis numbers as shown on the "Record of Chemical Analysis of Metal" attached hereto.

All material and each cylinder was inspected. All accepted material was found free from seams, cracks, laminations, and other defects which might prove injurious to the strength of the cylinder. The processes of manufacture and heat treatment (if any) were observed and found satisfactory.

My record of tests and inspection for each lot covered by this report is as follows:

Lot No.	Lot quality	Lot tests		All cylinders	
		Burst-pressure [1]	Flattening test [2]	Pressure tests [2]	Visual inspection [2]

Lot No.	Lot quality	Lot tests		All cylinders	
		Burst-pressure [1]	Flattening test [2]	Pressure tests [2]	Visual inspection [2]

[1] Enter the lowest actual failure pressure of all cylinders tested within the lot.

[2] Enter "Pass" or "Fail".

Inspector's name (print)

Date

Inspector's signature

Inspector's employer (company name)

[Amdt. 178-20, 36 FR 16582, Aug. 24, 1971; 36 FR 17343, Aug. 28, 1971]

§ 178.68 Specification 4E; welded aluminum cylinders.

§ 178.68-1 Compliance.

(a) Required in all details.

§ 178.68-2 Type, size and service pressure.

(a) *Type and size.* Must be constructed of not more than two seamless drawn shells with no more than one circumferential weld. The circumferential weld must not be closer to the point of tangency of the cylindrical portion with the shoulder than 20 times the cylinder wall thickness. Cylinders or shells closed in by spinning process and cylinders with longitudinal seams are not authorized. Authorized for not over 1,000 pounds water capacity (nominal).

(b) *Service pressure.*[1] At least 225 to not over 500 pounds per square inch.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-4, 34 FR 8167, May 24, 1969]

§ 178.68-3 Inspection by whom and where.

Inspections and verifications must be performed by an independent inspection agency approved in writing by the Associate Director for OE, in accordance with § 173.300a of this subchapter or, in the case of cylinders manufactured in the United States, a competent inspector of the manufacturer. Chemical analyses and tests as specified must be made within the United States unless otherwise approved in writing by the Associate Director for OE, in accordance with § 173.300b of this subchapter.

(46 U.S.C. 170(7); 49 CFR 1.53(f)-(h))

[Amdt. 178-39, 41 FR 18415, May 4, 1976, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.68-4 Duties of inspector.

(a) Inspect all material and reject any material not complying with requirements.

(b) Verify chemical analysis of each lot of material by analysis or by obtaining certified analysis: *Provided,* That a certificate from the manufacturer thereof, giving sufficient data to indicate compliance with requirements, is acceptable when verified by check analysis of samples taken from one aluminum cylinder out of each lot of 200 or less.

(c) Verify compliance of cylinders with all requirements including markings; inspect inside before closing in both ends; verify properties as proper; obtain samples for all tests and check chemical analysis; witness all tests; verify threads by gauge; report volumetric capacity, tare weight (see report form) and wall thickness as approved.

(d) Render complete report (§ 178.68-20) to purchaser; cylinder manufacturer; and the Associate Director for OE.

§ 178.68-5 Aluminum.

(a) Shall be of uniform quality. The following chemical analyses are authorized.

---

[1] The "service pressure" limits the use of the cylinder. It is shown by marks on cylinders; for example DOT-4E240 indicates the service pressure as 240 pounds per square inch.

TABLE I—AUTHORIZED MATERIALS

Designation	Chemical analysis—limits in percent 5154 [1]
Iron plus silicon	0.45 maximum.
Copper	0.10 maximum.
Manganese	0.10 maximum.
Magnesium	3.1/3.9.
Chromium	0.15/0.35.
Zinc	0.20 maximum.
Titanium	0.20 maximum.
Others, each	0.05 maximum.
Others, total	0.15 maximum.
Aluminum	Remainder.

[1] Analysis shall regularly be made only for the elements specifically mentioned above. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis should be made to determine conformance with the limits specified for other elements.

§ 178.68–6 Identification of material.

(a) Required; any suitable method that will identify the alloy and manufacturer's lot number.

§ 178.68–7 Defects.

(a) Material with seams, cracks, laminations or other injurious defects not authorized.

§ 178.68–8 Manufacture.

(a) By best processes and methods; dirt and foreign particles to be removed as necessary to afford proper inspection; no defect acceptable that is likely to weaken the finished cylinder appreciably; reasonably smooth and uniform surface finish required; all welding must be by the gas shielded arc process.

§ 178.68–9 Welding.

(a) The attachment to the tops and bottoms only of cylinders by welding of neckrings or flanges, footrings, handles, bosses and pads and valve protection rings is authorized: *Provided,* That such attachments and the portion of the cylinder to which it is attached are made of weldable aluminum alloys.

§ 178.68–10 Wall thickness.

(a) The minimum wall thickness of the cylinder shall be 0.140 inch. In any case, the minimum wall thickness shall be such that calculated wall stress at twice service pressure shall not exceed the lesser value of either of the following:

(1) 20,000 pounds per square inch.

(2) One-half of the minimum tensile strength of the material as required in § 178.63–15.

(b) Calculation must be made by the formula:

$$S=[P(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where:

S=wall stress in pounds per square inch;
P=minimum test pressure prescribed for water jacket test;
D=outside diameter in inches;
d=inside diameter in inches.

(c) Minimum thickness of heads and bottoms shall not be less than the minimum required thickness of the side wall.

§ 178.68–11 Opening in cylinder.

(a) All openings must be in the heads or bases.

(b) Each opening in cylinders, except those for safety devices, must be provided with a fitting, boss, or pad, securely attached to cylinder by welding by inert gas shielded arc process or by threads. If threads are used, they must comply with the following:

(1) Threads must be clean-cut, even, without checks and cut to gauge.

(2) Taper threads to be of length not less than as specified for American Standard taper pipe threads.

(3) Straight threads, having at least 4 engaged threads, to have tight fit and calculated shear strength at least 10 times the test pressure of the cylinder; gaskets required, adequate to prevent leakage.

(c) Closure of fitting, boss, or pad must be adequate to prevent leakage.

§ 178.68–12 Safety devices and protection for valves, safety devices, and other connections if applied.

(a) Must be as required by the Department of Transportation's regulations that apply (see §§ 173.34(d), 173.124(a)(2), and 173.301(g) of this chapter).

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–1, 33 FR 14934, Oct. 4, 1968; Amdt. 178–51, 43 FR 48645, Oct. 19, 1978]

§ 178.68-13 Hydrostatic test.

(a) By water jacket, or other suitable method, operated so as to obtain accurate data. Pressure gauge must permit reading to accuracy of 1 percent. Expansion gauge must permit reading of total expansion to accuracy either of 1 percent or 0.1 cubic centimeter.

(b) Pressure of 2 times service pressure must be maintained for 30 seconds and sufficiently longer to insure complete expansion. Any internal pressure applied previous to the official test must not exceed 90 percent of the test pressure. If, due to failure of the test apparatus, the test pressure cannot be maintained, the test may be repeated at a pressure increased by 10 percent over the pressure otherwise specified.

(c) Permanent volumetric expansion must not exceed 12 percent of total volumetric expansion at test pressure.

(d) Cylinders having a calculated wall stress of 18,000 pounds per square inch or less at test pressure may be tested as follows:

(1) At least one cylinder selected at random out of each lot of 200 or less shall be tested in accordance with paragraphs (a), (b), and (c) of this section.

(2) All cylinders not tested as provided in paragraph (d)(1) of this section must be examined under pressure of at least 2 times service pressure and show no defect.

(e) One finished cylinder selected at random out of each lot of 1,000 or less shall be hydrostatically tested to 4 times the service pressure without bursting. Inability to meet this requirement shall result in rejection of the lot.

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5752, Apr. 23, 1965; Order 71, 31 FR 9081, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.68-14 Flattening test.

(a) After hydrostatic testing, a flattening test is required on one section of a cylinder, taken at random out of each lot of 200 or less as follows:

(1) If the weld is not at midlength of the cylinder, the test section must be no less in width than 30 times the cylinder wall thickness. The weld must be in the center of the section. Weld reinforcement must be removed by machining or grinding so that the weld is flush with the exterior of the parent metal. There must be no evidence of cracking in the sample when it is flattened between flat plates to no more than 6 times the wall thickness.

(2) If the weld is at midlength of the cylinder, the test may be made as specified in paragraph (a)(1) of this section or must be made between wedge shaped knife edges (60° angle) rounded to a ½-inch radius. There must be no evidence of cracking in the sample when it is flattened to no more than 6 times the wall thickness.

[Amdt. 178-4, 34 FR 8167, May 24, 1969]

§ 178.68-15 Physical test.

(a) To determine yield strength, tensile strength, elongation, and reduction of area of material. Required on 2 specimens cut from one cylinder or part thereof taken at random out of each lot of 200 or less.

(b) Specimens must be: Gauge length 8 inches with width not over 1½ inches; or gauge length 2 inches with width not over 1½ inches. The specimen, exclusive of grip ends, must not be flattened. Grip ends may be flattened to within 1 inch of each end of the reduced section. When size of cylinder does not permit securing straight specimens, the specimens may be taken in any location or direction and may be straightened or flattened cold, by pressure only, not by blows; when specimens are so taken and prepared, the inspector's report must show in connection with record of physical test detailed information in regard to such specimens. Heating of specimen for any purpose is not authorized.

(c) The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length.

(1) The yield strength shall be determined by the "offset" method as prescribed in ASTM Standard E8-78.

(2) Cross-head speed of the testing machine shall not exceed ⅛ inch per minute during yield strength determination.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.68-16 Acceptable results for physical tests.

(a) Elongation at least 7 percent; yield strength not over 80 percent of tensile strength.

[Order 71, 31 FR 9081, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.68-17 Weld tests.

(a) Reduced section tensile test. A specimen shall be cut from the cylinder used for the physical tests specified in § 178.68-15. Specimen shall be taken across the seam, edges shall be parallel for a distance of approximately 2 inches on either side of the weld. The specimen must be fractured in tension. The apparent breaking stress calculated on the minimum wall thickness must be at least equal to 2 times the stress calculated under § 178.68-10(b), and in addition must have an actual breaking stress of at least 30,000 pounds per square inch. Should this specimen fail to meet the requirements, specimens may be taken from 2 additional cylinders from the same lot and tested. If either of the latter specimens fails to meet requirements, the entire lot represented shall be rejected.

(b) *Guided bend test.* A bend test specimen shall be cut from the cylinder used for the physical tests specified in § 178.68-15. Specimen shall be taken across the seam, shall be 1½ inches wide, edges shall be parallel and rounded with a file, and back-up strip, if used, shall be removed by machining. The specimen must be bent to refusal in the guided bend test jig illustrated in paragraph 6.10 of CGA Pamphlet C-3. The root of the weld (inside surface of the cylinder) shall be located away from the ram of the jig. No specimen shall show a crack or other open defect exceeding ⅛ inch in any direction upon completion of the test. Should this specimen fail to meet the requirements, specimens may be taken from each of 2 additional cylinders from the same lot and tested. If either of the latter specimens fail to meet requirements, the entire lot represented shall be rejected.

[29 FR 18826, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969]

§ 178.68-18 Rejected cylinders.

(a) Repair of welded seams is authorized. Acceptable cylinders must pass all prescribed tests.

§ 178.68-19 Marking.

(a) Marking on each cylinder by stamping plainly and permanently on shoulder, top head, neck or valve protection collar which may be permanently attached to the cylinder and forming an integral part thereof, as follows:

(1) DOT-4E followed by the service pressure (for example, DOT-4E240).

(2) A serial number and an identifying symbol (letters); location of the number to be just below or immediately following the DOT mark; location of symbol to be just below or immediately following the number. The symbol and numbers must be those of the maker, or of the purchaser or user if the maker's symbol also appears near the date of the original test. The symbol must be registered with the Associate Director for OE; duplications unauthorized.

Examples:

DOT-4E240

1234

XY

DOT-4E240-1234-XY

(3) Inspector's official mark, near serial number: Date of test (such as 5-50 for May 1950), so placed that date of subsequent test can be easily added.

(4) Size of marks. Shall be at least ¼ inch high.

(49 U.S.C. 1803, 1804, 1808 and 49 CFR 1.53(e))

[29 FR 18826, Dec. 29, 1964, as amended by Order 66, 30 FR 5752, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and further amended by Amdt. 178-40, 42 FR 2689, Jan. 13, 1977]

§ 178.68-20 Inspector's reports.

(a) Required to be clear, legible, and in following form:

(Place) ————————————

(Date) ————————————

Gas cylinders

Manufactured for ———— Company
Location at ————————————
Manufactured by ———— Company
Location at ————————————
Consigned to ———— Company
Location at ————————————
Quantity————————————
Size —— inches outside diameter by —— inches long.

Marks stamped into the shoulder of the cylinder are:
- Specification DOT ————————
- Serial numbers —— to —— inclusive.
- Inspector's mark ————————
- Identifying symbol (registered)————
- Test date ————————
- Tare weights (yes or no) ————
- Other marks (if any) ————————

These cylinders were made by process of —

————————————————

————————————————

The ———— (Neckrings, footrings, etc.) permitted in § 178.68-9 were attached by process of ————

The material used was identified by the following————————
numbers ————————

The material used was verified as to chemical analysis and record thereof is attached hereto.

All material, such as aluminum plate, was inspected before manufacture and the drawn cylinder shells were inspected before final fabrication and found free from seams, cracks, laminations and other defects which might prove injurious to the strength of the cylinder; the processes of manufacture were found to be efficient and satisfactory.

The cylinder walls were measured and the minimum thickness noted was ——inch. The outside diameter was determined by a close approximation to be ———inches. The wall stress was calculated to be —— pounds per square inch under an internal pressure of ——— pounds per square inch.

Hydrostatic tests, flattening tests, tensile tests of material and other tests as prescribed in Specification DOT-4E were made in the presence of the inspector and all material and cylinders accepted were found to be in compliance with the requirements of that specification. Records thereof are attached hereto.

I hereby certify that all of these cylinders proved satisfactory in every way and comply with the requirements of Department of Transportation specification No. 4E except as follows:

Exceptions: ————————————

————————————————

(Signed) ————————
Inspector.
(Place) ————————
(Date) ————————

RECORD OF CHEMICAL ANALYSIS OF MATERIAL FOR CYLINDERS

Numbered ——— to ——— inclusive.
Size ——— inches outside diameter by ——— inches long.
Made by ———————— Company
For ———————— Company

NOTE: Any omission of analyses by heats, if authorized, must be accounted for by notation hereon reading "The prescribed certificate of the manufacturer of material has been secured, found satisfactory, and placed on file," or by attaching a copy of the certificate.

Test No.	Check analysis No.	Cylinders represented (serial Nos.)	Chemical analysis							
			Mg	Cr	Cu	Mn	Zn	Ir	Al	Ti

The analyses were made by ....

(Signed) ....
(Place) ....
(Date) ....

RECORD OF PHYSICAL TESTS OF MATERIAL FOR CYLINDERS

Numbered .... to .... inclusive
Size .... inches outside diameter by .... inches long
Made by .... Company
For .... Company

Test No.	Cylinders represented by test (Serial Nos.)	Yield strength (pounds per sq. inch)	Tensile strength (pounds per sq. inch)	Elongation (percent in 8 inches)	Reduction of area (percent)	Flattening test	Burst test (pounds per sq. inch)

(Signed) ....
(Place)..
(Date)..

RECORD OF HYDROSTATIC TESTS ON CYLINDERS

Numbered.. to .... inclusive
Size .... inches outside diameter by.. inches long
Made by .... Company
For.. Company

Serial Nos. of cylinders tested arranged numerically	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters) [1]	Permanent expansion (cubic centimeters) [1]	Percent ratio of permanent expansion to total expansion [1]	Tare weight (pounds) [2]	Volumetric capacity [3]

NOTE: When specifications require test for only 1 out of each lot of 200 or less cylinders, the check on the others must be indicated by a notation hereon reading, "Each cylinder was subjected to a pressure of ——— pounds per square inch and showed no defect."

[1] If the tests are made by a method involving the measurement of the amount of liquid forced into the cylinder by the test pressure, then the basic data, on which the calculations are made, such as the pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include removable cap but state whether with or without valve. These weights must be accurate to a tolerance of 1 percent.

[3] Report approximate maximum and minimum volumetric capacity for the lot.

(Signed) ....

Subpart D—Specifications for Metal Barrels, Drums, Kegs, Cases, Trunks, and Boxes

SOURCE: 29 FR 18893, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§ 178.80 Specification 5; steel barrels or drums.

Removable head containers which will pass all required tests are authorized.

§ 178.80-1 Compliance.

(a) Required in all details.

§ 178.80-2 Rated capacity.

(a) Rated capacity as marked, see § 178.80-11(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 178.80-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel. Stainless steel, when used, must be, except for rolling hoops and chime reinforcement, an austenitic 18 or 8 chrome nickel alloy with carbon content not over 0.08 percent, or other equivalent grades.

§ 178.80-5 Seams.

(a) Body seams welded.

§ 178.80-6 Chime reinforcement.

(a) Containers over 25 gallons capacity, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 178.80-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type [1]	Minimum Size (gauge or inch)	Minimum Weight (pounds per foot)
5	Straight side	22	22	None		
10	do	20	20	do		
33	do	14	14	do		
33	do	18	18	U	16	
55	do	16	16	U[3]	14	
110	do	14	14	U[2]	12	
33	do	18	18	I-bar	¾ × 1¼	1.25
55	do	16	16	I-bar[3]	¾ × 1¼	1.25
110	do	14	14	I-bar[3]	¾ × 1¼	1.25
33	do	16	16	(2)		
55	do	14	14	(2 3)		
33	Bilge	14	16	None		
55	do	13	14	do		

[1] Rolling hoops may be of pliable solid rubber, metal, or other suitable material provided that equivalent protection to drum integrity is afforded.

[2] Rolled or swedged in hoops.

[3] In addition to the normal rolling hoops, the body of each removable head drum must have a rolled or swedged in hoop the center-line of which shall be not more than 3 inches from the top curl.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
13	0.0897	0.0817
14	.0747	.0677
16	.0598	.0533
18	.0478	.0428
20	.0359	.0324
22	.0299	.0269

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§ 178.80-8 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops not permitted. Attachment to drum body by spot welding, except for continuous resistance method, not permitted. Welding of I-bar type directly to body of drum in any manner not permitted.

§ 178.80-9 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.7 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.,) for plug, or cap, must have 3 or more complete threads; two drainage holes of not over 5/16-inch diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 3 threads when screwed home with gasket in place.

(d) Full removable head drums over 5 gallons capacity must be closed by means of 12 gauge bolted ring with drop forged lugs, one of which is threaded, and having ⅜ inch bolt and nut for drums not over 30 gallons capacity and ⅝ inch bolt and nut for drums over 30 gallons capacity. Five gallon drums must be of lug type closure with cover having at least 16 lugs. Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§ 178.80-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.80-11 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) DOT-5. In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, DOT-5-304 or DOT-5-304 HT as applicable), shall be shown.

(2) Name or symbol of person making the marks specified in paragraph (a) (1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5752, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.80-11 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.80-12 Size of markings.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 178.80-13 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from heights of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 40 pounds per square inch sustained for 5 minutes; except that full removable head drums must sustain 20 pounds per square inch.

(3) Periodic drop and hydrostatic tests are not required when containers fabricated of stainless steel have satisfactorily withstood prescribed tests at the original start of production. Satisfactory test results must be obtained on samples of subsequent containers that have been altered in design or construction. In instances where manufacturers have suspended production for an interval of 12 months or more, drop and hydrostatic tests must be again conducted as prescribed in paragraphs (a) (1) and (2) of this section as

for original start of production. Samples last tested to be retained until further tests are made or for one year, whichever period is shorter.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5752, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.80-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure. Removable head containers need not be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every 4 months. Samples last tested must be retained until further tests are made or for 1 year.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66198, Nov. 19, 1979]

§ 178.81 Specification 5A; steel barrels or drums.

Removable head containers not authorized.

§ 178.81-1 Compliance.

(a) Required in all details.

§ 178.81-2 Rated capacity.

(a) Rated capacity as marked, see § 178.81-11 (a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 178.81-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.81-5 Seams.

(a) Body seams welded.

(b) Head and chime seams welded or double-seamed.

(c) Flanges for closures welded in place.

§ 178.81-6 Chime reinforcement.

(a) Containers over 25 gallons capacity, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 178.81-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type [1]	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
10	Straight side	16	16	None		
30	......do	16	16	I-bar	¾ × 1¼	1.25
55	......do	14	14	I-bar	......do	1.60
110	......do	12	12	......do	......do	1.60
30	Bilge	14	16	None		
55	......do	13	14	......do		

[1] Rolling hoops may be of pliable solid rubber, metal, or other suitable material provided that equivalent protection to drum integrity is afforded.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
12	0.1046	0.0946
13	.0897	.0817

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
14	.0747	.0677
16	.0598	.0533

[1] Thickness shall be measured at any point on the sheet not less than ¾ inch from an edge.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-36, 39 FR 44990, Dec. 30, 1974; Amdt. 178-59, 44 FR 66199, Nov. 19, 1979]

§ 178.81-8 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or welding of the rolling hoops directly to the body of the drum in any manner is not permitted.

§ 178.81-9 Closures.

(a) Adequate to prevent leakage; gasket required. Closure must be of screw-thread type or fastened by screw-thread device. Unthreaded cap is authorized for containers of 12 gallons or less if cap is provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

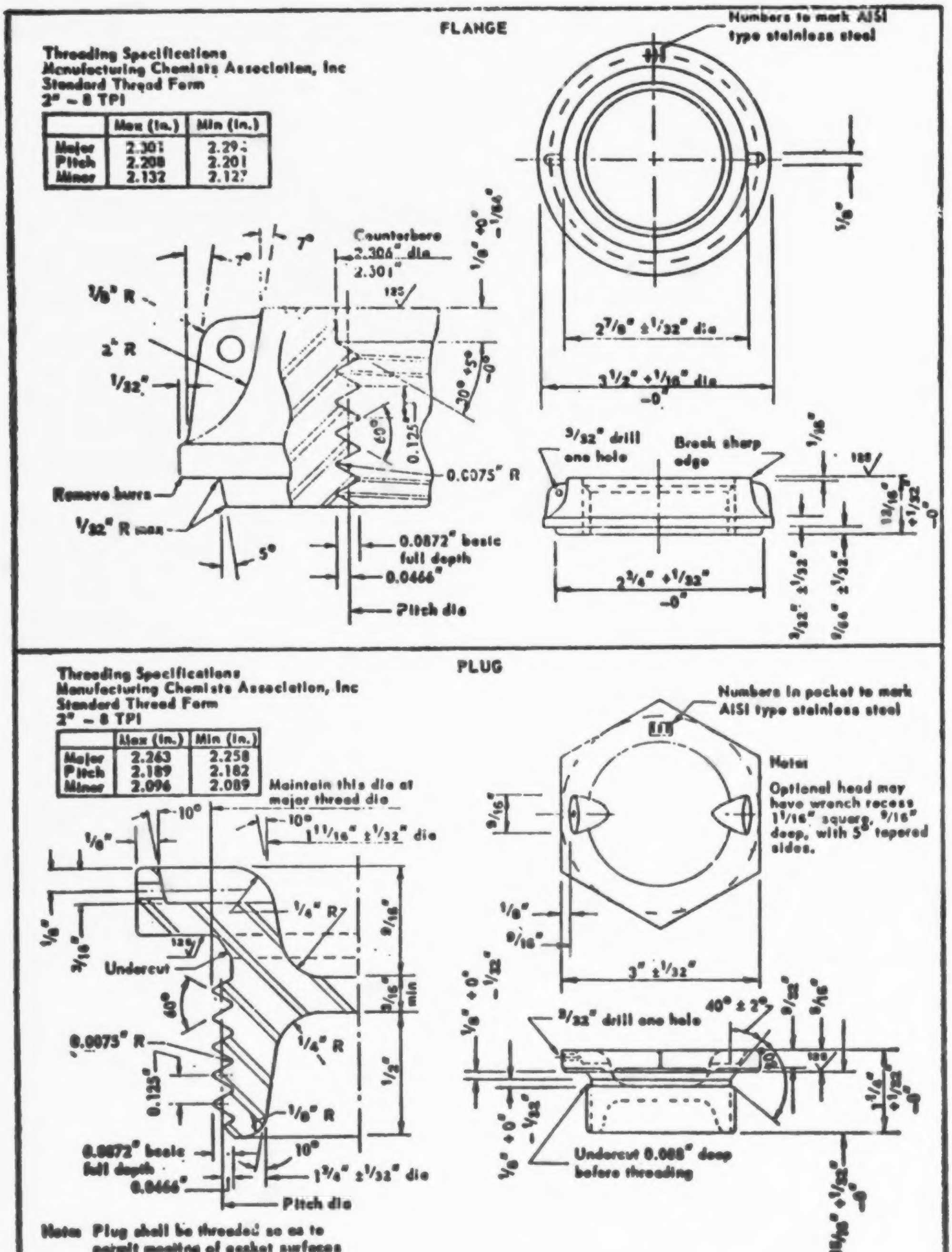
(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or cap must have 5 or more complete threads; 2 drainage holes of not over 5/16" diameter are allowed in that section of flange which extends inside the drum. Plug or cap must have sufficient length of thread to engage 5 threads when securely tightened with gasket in place.

(d) Openings over 2.3" diameter not permitted. Threads for plug or cap must be 8 or less per inch when over ¾" standard pipe size. Flanges with inside threads and plugs must conform with the thread diameter and thread form shown in the following drawing; other details shown on the drawing are recommended.

(1)



FLANGE

Threading Specifications
Manufacturing Chemists Association, Inc
Standard Thread Form
2" – 8 TPI

	Max (in.)	Min (in.)
Major	2.301	2.29[illegible]
Pitch	2.208	2.201
Minor	2.132	2.127

7°
7°
Counterbore 2.306" dia
2.301"
125
1/8" R
2" R
1/32"
1/8" +0" −1/64"
30° +5° −0°
60°
0.125"
0.0075" R
Remove burrs
1/32" R max
5°
0.0872" basic full depth
0.0466"
Pitch dia
Numbers to mark AISI type stainless steel
1/8"
2 7/8" ±1/32" dia
3 1/2" +1/16" dia −0"
3/32" drill one hole
Break sharp edge
1/16"
125
13/16" +1/32" −0"
2 3/4" +1/32" −0"
3/32" ±1/32"
9/64" ±1/32"

PLUG

Threading Specifications
Manufacturing Chemists Association, Inc
Standard Thread Form
2" – 8 TPI

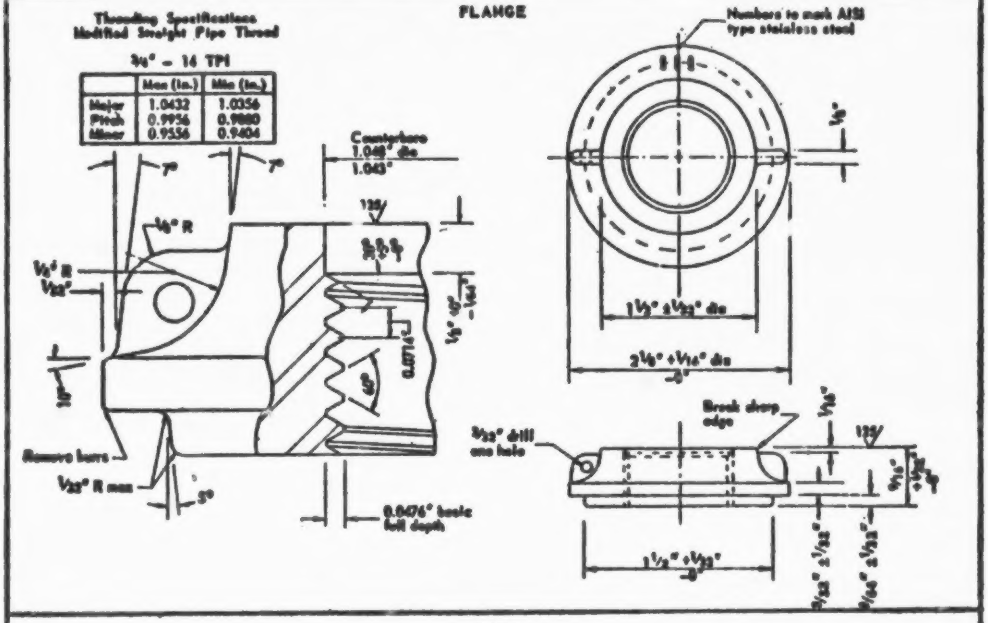
	Max (in.)	Min (in.)
Major	2.263	2.258
Pitch	2.189	2.182
Minor	2.096	2.089

Maintain this dia at major thread dia
10°
1/8"
10°
1 11/16" ±1/32" dia
1/8"
7/16"
125
Undercut
1/4" R
9/16"
3/16" min
60°
0.0075" R
1/4" R
0.125"
1/2"
1/8" R
0.0872" basic full depth
0.0466"
10°
1 3/4" ±1/32" dia
Pitch dia
Numbers in pocket to mark AISI type stainless steel
9/16"
1/8"
9/16"
3" ±1/32"
1/8" +0" −1/32"
3/32" drill one hole
40° ± 2°
3/32"
9/16"
125
1 1/4" +1/32" −0"
1/8" +0" −1/32"
Undercut 0.088" deep before threading
15/16" +1/32" −0"

Note: Optional head may have wrench recess 1 1/16" square, 9/16" deep, with 5° tapered sides.

Note: Plug shall be threaded so as to permit meeting of gasket surfaces when assembled, without gasket, in flange.

FLANGE

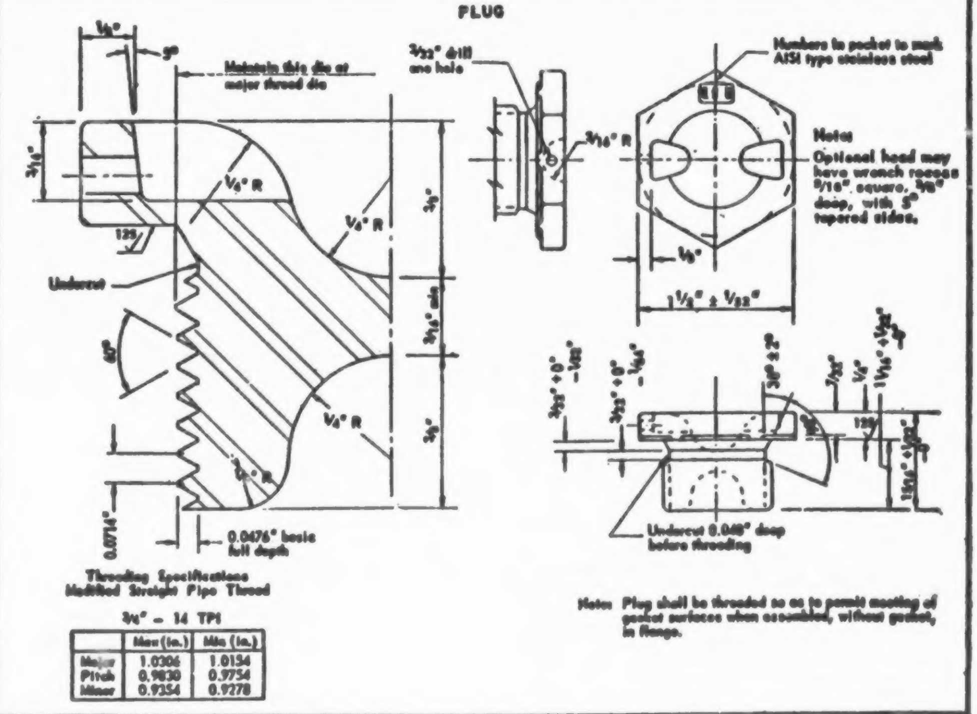

7°
7°
Counterbore
1.048" dia
1.043"
125/
1/8" R
1/8" R
1/32"
1/8" +0"
−1/64"
0.0714"
60°
Remove burrs
1/32" R max
5°
0.0476" basic
full depth
Numbers to mark AISI
type stainless steel
1/8"
1 1/2" ±1/32" dia
2 1/8" +1/16" dia
−0"
Break sharp
edge
3/32" drill
one hole
1/16"
125/
9/16"
+1/32"
−0"
1 1/2" +1/32"
−0"
3/32" ±1/32"
9/64" ±1/32"

Threading Specifications
Modified Straight Pipe Thread

3/4" – 14 TPI

	Max (in.)	Min (in.)
Major	1.0432	1.0356
Pitch	0.9956	0.9880
Minor	0.9556	0.9404

PLUG


1/8"
5°
Maintain this dia at
major thread dia
3/16"
1/8" R
1/8" R
125/
Undercut
60°
1/8" R
1/8" R
0.0714"
0.0476" basic
full depth
3/4"
3/16" min
3/4"
3/32" drill
one hole
3/16" R
Numbers to pocket to mark
AISI type stainless steel
1/8"
1 1/2" ± 1/32"
3/32" +0"
−1/32"
3/32" +0"
−1/64"
30° ± 2°
1/32"
1/4"
11/16" +1/32"
−0"
125/
15/32" +1/32"
−0"
Undercut 0.048" deep
before threading

Note:
Optional head may have wrench recess 9/16" square, 3/8" deep, with 5° tapered sides.

Threading Specifications
Modified Straight Pipe Thread

3/4" – 14 TPI

	Max (in.)	Min (in.)
Major	1.0306	1.0154
Pitch	0.9830	0.9754
Minor	0.9354	0.9278

Note: Plug shall be threaded so as to permit meeting of gasket surfaces when assembled, without gasket, in flange.

(e) Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66199, Nov. 19, 1979]

§ 178.81-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.81-11 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) DOT-5A. In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, DOT-5A-304 or DOT-5A-304 HT as applicable), shall be shown.

(2) Name or symbol of person making the marks specified in paragraph (a) (1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5752, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.81-11 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.81-12 Size of markings.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 178.81-13 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5752, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.81-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66199, Nov. 19, 1979]

§ 178.82 Specification 5B; steel barrels or drums.

Removable head containers which will pass all required tests are authorized.

§ 178.82-1 Compliance.

(a) Required in all details.

§ 178.82-2 Rated capacity.

(a) Rated capacity as marked, see § 178.82-11(a)(3). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater. Actual capacity of bilge type containers must be not less than rated (marked) capacity, nor greater than rated (marked) capacity plus 2 percent plus 2 quarts.

§ 178.82-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.82-5 Seams.

(a) Body seams welded.

§ 178.82-6 Chime reinforcement.

(a) Containers over 25 gallons capacity, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 178.82-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type [1]	Minimum Size (gauge or inch)	Minimum Weight (pounds per foot)
5	Straight side	24	24	None		
10	do	22	22	do		
15	do	20	20	(2)		
33	do	18	18	(2)		
55	do	16	16	(2 3)		
110	do	13	14	(2 3)		
33	Bilge	16	16	None		
55	do	14	14	do		

[1] Rolling hoops may be of pliable solid rubber, metal, or other suitable material provided that equivalent protection to drum integrity is afforded.

[2] Rolled or swedged in hoops.

[3] Each removable head drum body must have three rolled or swedged in hoops with the center-line of one not more than 3 inches from the top curl.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
13	0.0897	0.0817
14	.0747	.0677
16	.0598	.0533
18	.0478	.0428
20	.0359	.0324
22	.0299	.0269
24	.0239	.0209

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66199, Nov. 19, 1979]

§ 178.82-8 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 178.82-9 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal (see paragraph (c) of this section) as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.7 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug or cap, must have 3 or more complete threads; two drainage holes of not over 5/16-inch diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 3 threads when tightened with gasket in place. Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

(d) Full removable head drums over 5 gallons capacity must be closed by means of 12 gauge bolted ring with drop forged lugs, one of which is threaded, and having ⅜ inch bolt and nut for drums not over 30 gallons capacity and ⅝ inch bolt and nut for drums over 30 gallons capacity. Five gallon drums must be of lug type closure with cover having at least 16 lugs. Other types of closures are authorized if they perform without failure under the tests required by this section and a record of such tests is retained during the period the closure is in use.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964, as amended by Order 67, 30 FR 7425, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and further amended by Amdt. 178-59, 44 FR 66199, Nov. 19, 1979]

§ 178.82-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.82-11 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) DOT-5B. In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture, (for example, DOT-5B-304, or DOT-5B-304 HT as applicable), shall be shown.

(2) Name or symbol of person making the marks specified in paragraph (a) (1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in the head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5752, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.82-11 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.82-12 Size of markings.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 178.82-13 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime

or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure tests of 40 pounds per square inch sustained for 5 minutes; except that full removable head drums must sustain 20 pounds per square inch.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5752, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.82-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure. Removable head containers need not be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every 4 months. Samples last tested must be retained until further tests are made or for 1 year.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66199, Nov. 19, 1979]

§ 178.83 Specification 5C; steel barrels or drums.

Removable head containers not authorized.

§ 178.83-1 Compliance.

(a) Required in all details.

§ 178.83-2 Rated capacity.

(a) Rated capacity as marked, see § 178.83-11(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity; nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 178.83-3 Composition.

(a) Steel must be, except for rolling hoops and chime reinforcement, as follows:

(b) All sheet metal, welding rod, closing devices, and samples taken from the welded portion of the finished container must be of Type 304, 18 chrome 8 nickel alloy with 0.08 percent chromium, 8-11 percent nickel, or other types of stainless steel of equivalent corrosion resistance and physical properties.

(c) Type 304 or other grades of equivalent corrosion resistant steels in the as-welded condition are permissible for nitric acid concentrations up to and including 78 percent. For all concentrations of nitric acid the following are permissible:

(1) Type 304 heat-treated (quenches from 1900° F.), or

(2) Stabilized Type 347 in the as-welded condition, or

(3) Stabilized Type 347 stress-relieved (1550°-1650° F.), or

(4) Stabilized Type 347 heat-treated (quenches from 1900° F.), or

(5) Other grades of equivalent corrosion resistance.

(d) All parts of any completed container exposed to lading must comply with the standard 65 percent boiling nitric acid test in that the limit of inches per month penetration in accordance with corrosion test as used in American Society of Testing Materials Standard A-262-44-T shall be 0.0015 inch, this figure to be an average of five 48-hour tests.

§ 178.83-5 Seams.

(a) Body seams welded.

(b) Chime seams welded or double-seamed and welded.

(c) Flanges for closures welded in place.

§ 178.83-6 Chime reinforcement.

(a) Containers of 10 gallons capacity or over, with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 178.83-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type [1]	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
15	Straight side	20	20	None		
30	......do	18	18	I-bar	¾ × 1¼	1.25
55	......do	16	16	I-bar [2]	¾ × 1¼	1.60
110	......do	14	14	......do [2]	¾ × 1¼	1.60
15	Bilge	16	16	None		
30	......do	14	16	......do		
55	......do	13	14	......do		

[1] Rolling hoops may be of pliable solid rubber, metal, or other suitable material provided that equivalent protection to drum integrity is afforded.

[2] Stainless steel I-bar rolling hoops ¾ × 1¼ inches, weighing not less than 1.27 pounds per foot, are authorized.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
13	0.0897	0.0817
14	.0747	.0677
16	.0598	.0533
18	.0478	.0428
20	.0359	.0324

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-36, 39 FR 44990, Dec. 30, 1974; Amdt. 178-59, 44 FR 66199, Nov. 19, 1979; Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.83-8 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 178.83-9 Closures.

(a) Adequate to prevent leakage; gaskets required. Closure must be of screw-thread type or fastened by screw-thread device. Unthreaded cap is authorized for containers of 12 gallons or less if cap is provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

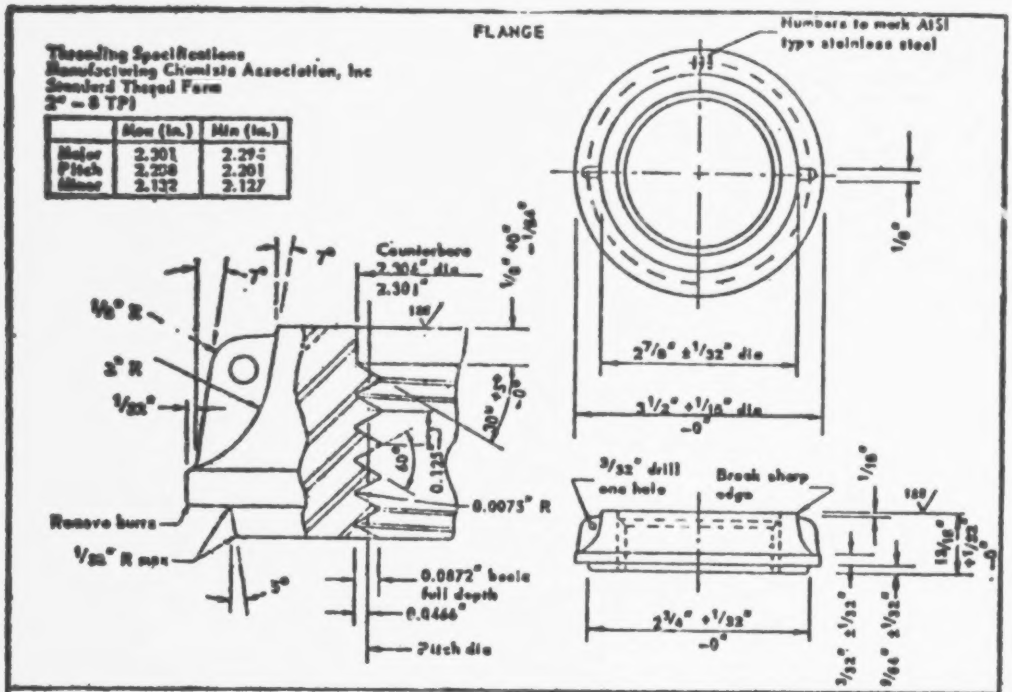
(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug or cap must have 5 or more complete threads; 2 drainage holes of not over ⁵⁄₁₆ inch diameter are allowed in that section of flange which extends inside the drum. Plug or cap must have sufficient length of thread to engage 5 threads when securely tightened with gasket in place. Except that for containers not over 15 gallons marked capacity the seat (flange, etc.) for plug or cap may have at least 3 complete threads and plug or cap sufficient length of thread to engage 3 threads when securely tightened with gasket in place.

(d) Openings over 2.3 inches are not permitted. Threads for plug or cap must be 8 or less per inch when over ¾ inch standard pipe size.

(1) Flanges with inside threads and plug must conform with the thread diameter and thread form shown in the following drawing (other details shown on the drawing are recommended):

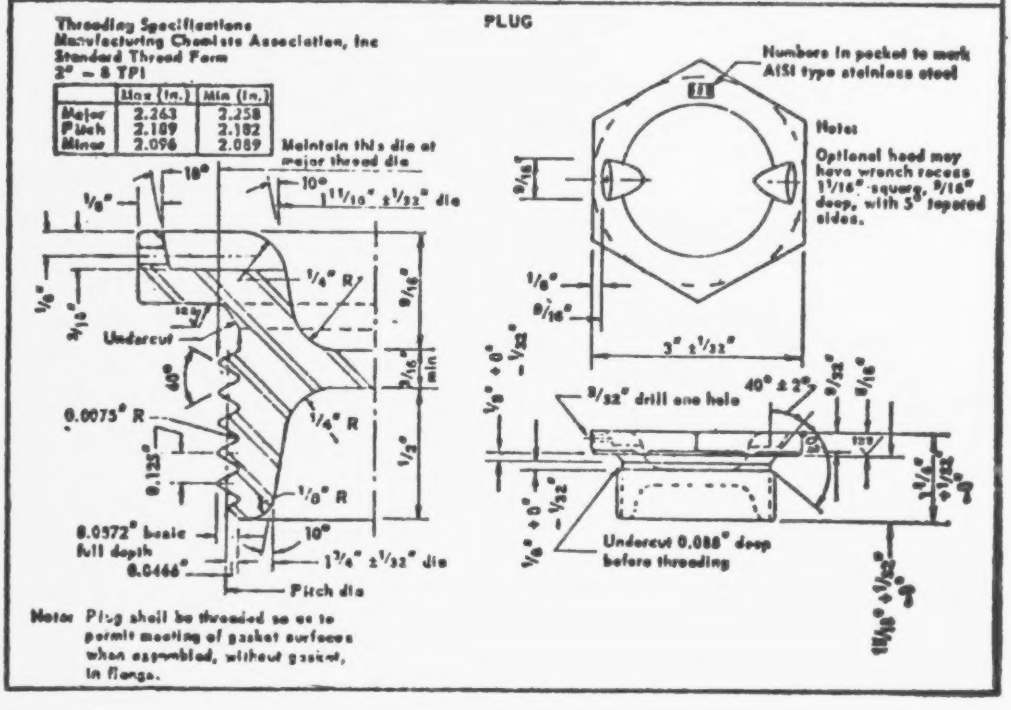


FLANGE

Threading Specifications
Manufacturing Chemists Association, Inc
Standard Thread Form
2" – 8 TPI

	Max (in.)	Min (in.)
Major	2.301	2.296
Pitch	2.208	2.201
Minor	2.132	2.127

Numbers to mark AISI type stainless steel
7°
7°
Counterbore 2.306" dia 2.301"
1/8" R
2" R
1/32"
Remove burrs
1/32" R max
5°
1/8" +0" −1/64"
30° +5° −0°
40°
0.125"
0.0075" R
0.0872" basic full depth
0.0466"
Pitch dia
2 7/8" ±1/32" dia
3 1/2" +1/16" −0" dia
1/8"
3/32" drill one hole
Break sharp edge
1/16"
2 3/4" +1/32" −0"
13/16" +1/32" −0"
3/32" ±1/32"
9/64" ±1/32"



PLUG

Threading Specifications
Manufacturing Chemists Association, Inc
Standard Thread Form
2" – 8 TPI

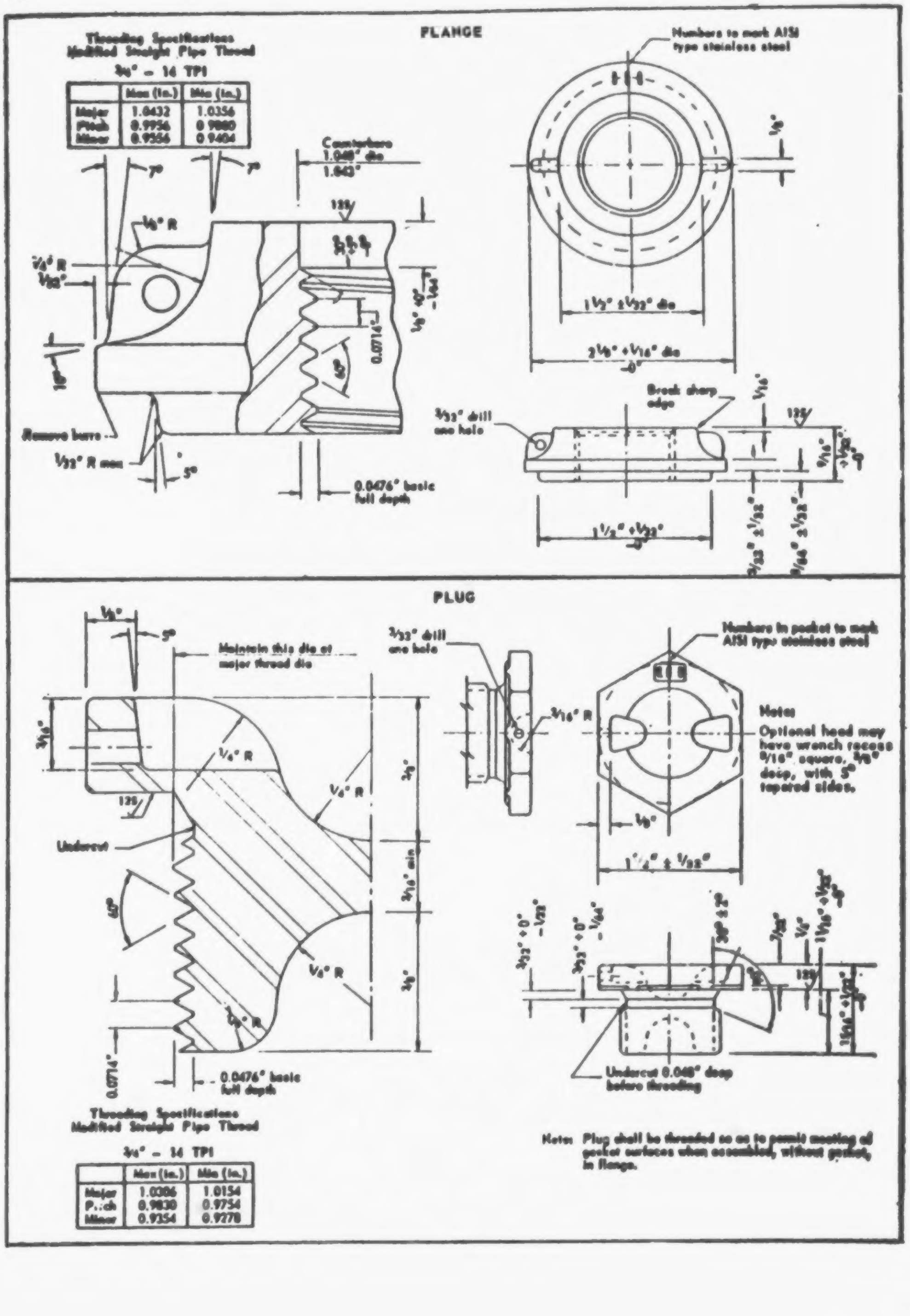
	Max (in.)	Min (in.)
Major	2.263	2.258
Pitch	2.189	2.182
Minor	2.096	2.089

Note: Plug shall be threaded so as to permit meeting of gasket surfaces when assembled, without gasket, in flange.

Note: Optional head may have wrench recess 1 1/16" square, 9/16" deep, with 5° tapered sides.

Maintain this dia at major thread dia
10°
10°
1 11/16" ±1/32" dia
1/8"
1/8"
9/16"
1/4" R
9/16"
Undercut
3/16" min
40°
0.0075" R
1/4" R
1/2"
0.125"
1/8" R
0.0872" basic full depth
0.0466"
10°
1 3/4" ±1/32" dia
Pitch dia
Numbers in pocket to mark AISI type stainless steel
9/16"
1/8"
9/16"
3" ±1/32"
1/8" +0" −1/32"
3/32" drill one hole
40° ± 2°
9/32"
5/16"
1 1/16" +1/32" −0"
1/8" +0" −1/32"
Undercut 0.088" deep before threading
15/16" +1/32" −0"

(i)


FLANGE
Counterbore 1.048" dia
1.843"
125
1/8" R
3/32" R
1/32"
1/8"
Remove burrs
1/32" R max
5°
7°
60°
0.0714"
0.0476" basic full depth
Numbers to mark AISI type stainless steel
1/8"
1 1/2" ±1/32" dia
2 1/8" +1/16" dia −0"
Break sharp edge
3/32" drill one hole
1/16"
9/16"
1 1/2" +1/32" −0"
PLUG
1/8"
5°
Maintain this dia at major thread dia
3/16"
1/4" R
1/4" R
125
Undercut
60°
1/4" R
1/8" R
0.0714"
0.0476" basic full depth
3/32" drill one hole
3/16" R
Numbers in pocket to mark AISI type stainless steel
Note: Optional head may have wrench recess 9/16" square, 1/8" deep, with 5° tapered sides.
1/8"
1 1/4" ± 1/32"
30° ±2°
125
Undercut 0.048" deep before threading

Threading Specifications
Modified Straight Pipe Thread
3/4" – 14 TPI

	Max (in.)	Min (in.)
Major	1.0432	1.0356
Pitch	0.9956	0.9880
Minor	0.9556	0.9404

Threading Specifications
Modified Straight Pipe Thread
3/4" – 14 TPI

	Max (in.)	Min (in.)
Major	1.0306	1.0154
Pitch	0.9830	0.9754
Minor	0.9354	0.9278

Note: Plug shall be threaded so as to permit meeting of gasket surfaces when assembled, without gasket, in flange.

or (2) Eleven and one-half (11½) threads per inch, standard pipe size.

(e) Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66199, Nov. 19, 1979]

§ 178.83-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.83-11 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) DOT-5C, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and, in addition, the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, DOT-5C-304 or DOT-5C-304HT as applicable).

(2) Name or symbol of person making the marks specified in paragraph (a) (1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

(4) Tare weight in pounds preceded by the letters "TW" (for example TW121), except marking may be either embossed or stamped.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5753, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.83-11 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.83-12 Size of marking.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 178.83-13 Type tests.

(a) Samples, taken at random and closed as for use, must be capable of withstanding prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months, except as provided in paragraph (a)(3) of this section. Samples last tested to be retained until further tests are made or for one year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

(3) Periodic drop and hydrostatic tests are not required where container has satisfactorily met prescribed tests at the original start of production. Satisfactory test results must be obtained on samples of subsequent containers that have been altered in design or construction. Samples so tested must be retained until further tests are made or for one year, whichever period is shorter.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5753, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.83-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66199, Nov. 19, 1979]

§ 178.88 Specification 5K; nickel barrels or drums.

Removable head containers not authorized.

§ 178.88-1 Compliance.

(a) Required in all details.

§ 178.88-2 Rated capacity.

(a) Rated capacity as marked, see § 178.88-10(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 178.88-3 Composition.

(a) Material must be, except for rolling hoops and chime reinforcements, nickel at least 99.0 percent pure.

§ 178.88-4 Seams.

(a) Body seams welded.

(b) Head and chime seams welded or double-seamed.

(c) Flanges for closures welded in place.

§ 178.88-5 Chime reinforcement.

(a) Containers over 25 gallons capacity with flanged head secured to body, to have chime reinforcement adequate for its protection.

§ 178.88-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness in black (gauge, United States Standard)		Rolling hoops		
				Type [1]	Minimum	
		Body sheet	Head sheet		Size (gauge or inch)	Weight (pounds per foot)
10	Straight side	16	16	None		
30	do	16	16	I-bar	¾ × 1¼	1.25
55	do	14	14	do	¾ × 1¼	1.60
110	do	12	12	do	¾ × 1¼	1.60
30	Bilge	14	16	None		
55	do	13	14	do		

[1] Rolling hoops may be of pliable solid rubber, metal, or other suitable material provided that equivalent protection to drum integrity is afforded.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-36; 39 FR 44990, Dec. 30, 1974; Amdt. 178-59, 44 FR 66200, Nov. 19, 1979]

§ 178.88-7 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 178.88-8 Closures.

(a) Adequate to prevent leakage; gaskets required. Closure must be of screw-thread type or fastened by screw-thread device. Unthreaded cap is authorized for containers of 12 gallons or less if cap is provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

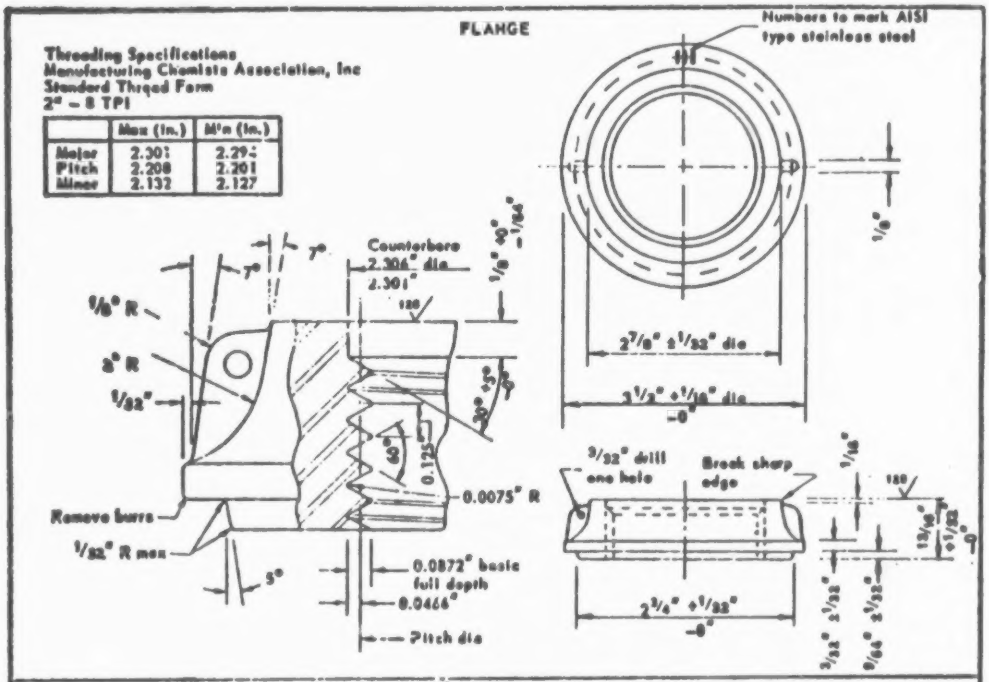
(b) Closing part (plug, cap, plate, etc. see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug or cap must have 5 or more complete threads; 2 drainage holes of not over 5/16-inch diameter are allowed in that section of flange which extends inside the drum. Plug or cap must have sufficient length of thread to engage 5 threads when securely tightened with gasket in place.

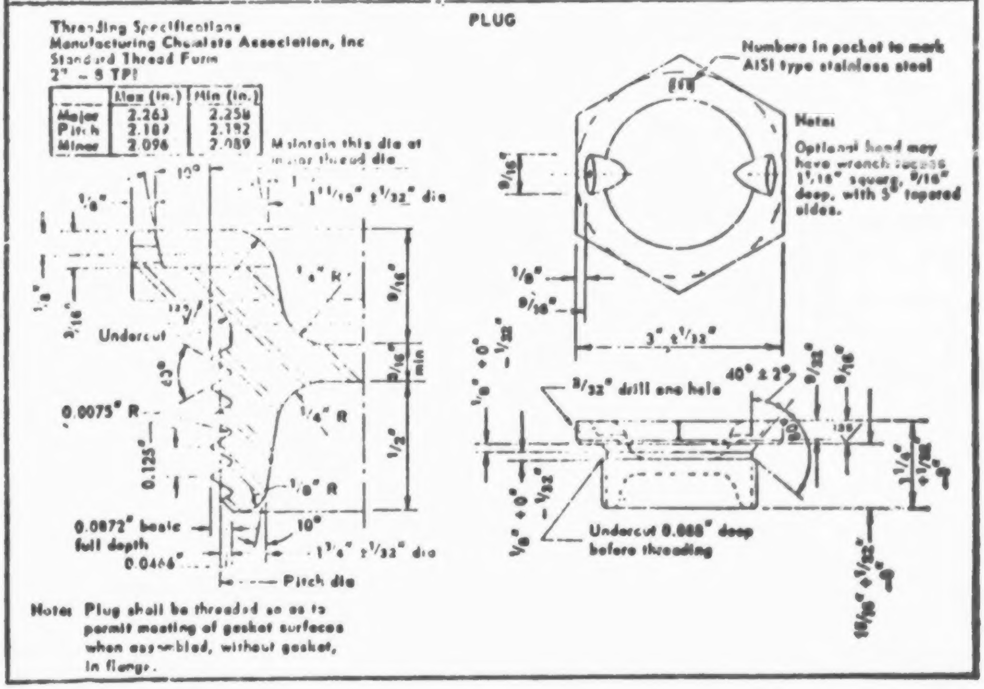
(d) Openings over 2.3 inches in diameter are not permitted. Threads for plug or cap must be 8 or less per inch when over ¾ inch standard pipe size.

(1) Flanges with inside threads and plug must conform with the thread diameter and thread form shown in the following drawing (other details shown on the drawing are recommended),


FLANGE
Numbers to mark AISI type stainless steel
Countorbore 2.306" dia
2.301"
1/8" 40° −1/64"
1/8" R
2" R
1/32"
7°
7°
30° ±2° −0°
60°
0.125"
0.0075" R
Remove burrs
1/32" R max
5°
0.0872" basic full depth
0.0466"
Pitch dia
1/8"
2 7/8" ±1/32" dia
3 1/2" +1/16" dia −0"
3/32" drill one hole
Break sharp edge
1/16"
13/16" +1/32" −0"
2 3/4" +1/32" −0"
3/32" ±1/32"
9/64" ±1/32"

Threading Specifications
Manufacturing Chemists Association, Inc
Standard Thread Form
2" – 8 TPI

	Max (in.)	Min (in.)
Major	2.301	2.29[illegible]
Pitch	2.208	2.201
Minor	2.132	2.127


PLUG
Numbers in pocket to mark AISI type stainless steel
Maintain this dia at minor thread dia
10°
1/8"
1 11/16" ±1/32" dia
1/4" R
9/16"
3/16"
1/8"
Undercut
3/16" min
45°
0.0075" R
1/4" R
1/2"
0.125"
1/8" R
10°
0.0872" basic full depth
0.0466"
1 3/4" ±1/32" dia
Pitch dia
9/16"
1/8"
9/16"
3" ±1/32"
1/8" +0" −1/32"
3/32" drill one hole
40° ±2°
9/32"
5/16"
1 1/4" +1/16" −0"
1/8" +0" −1/32"
Undercut 0.088" deep before threading
15/16" +1/32" −0"

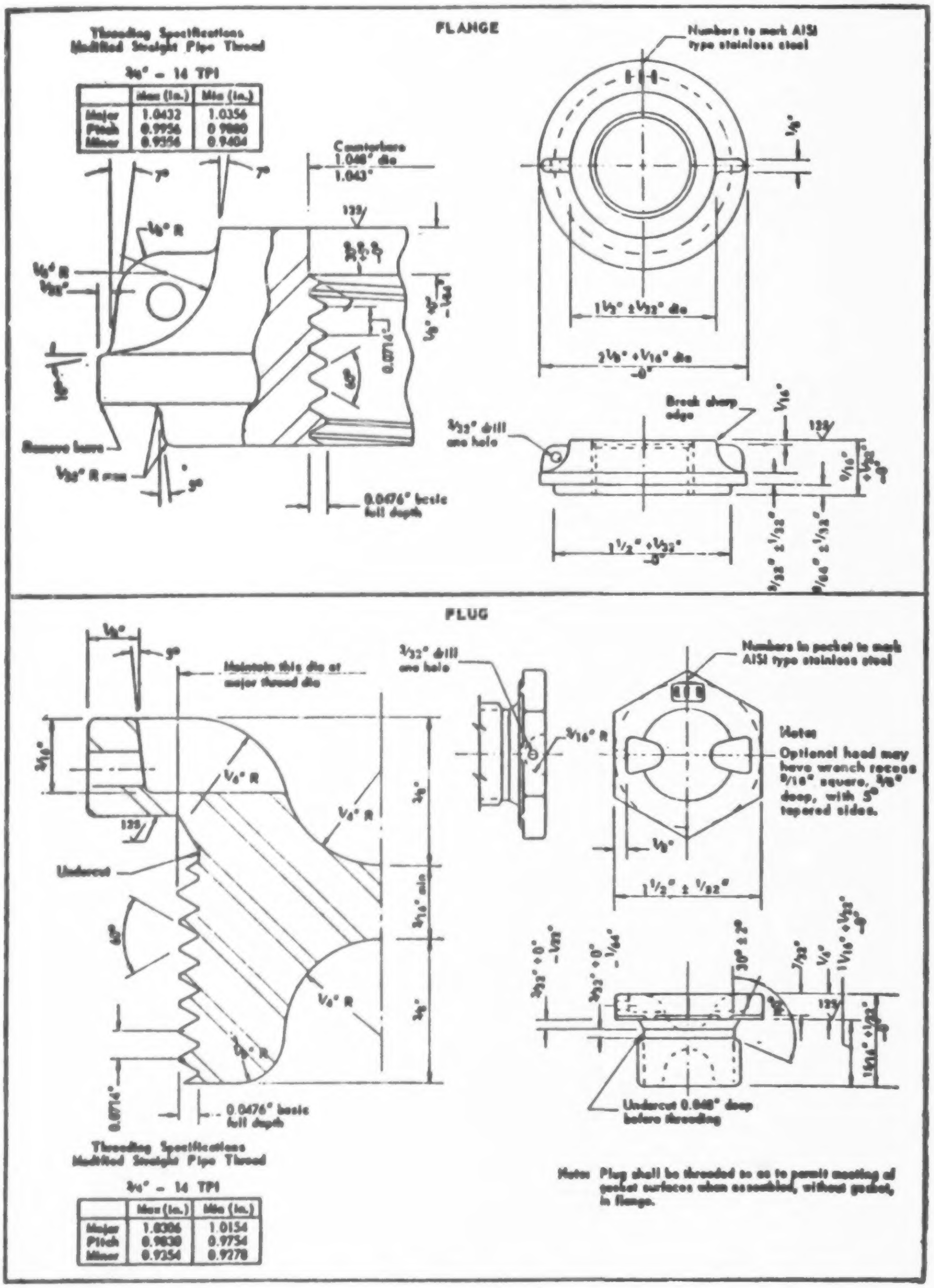
Threading Specifications
Manufacturing Chemists Association, Inc
Standard Thread Form
2" – 8 TPI

	Max (in.)	Min (in.)
Major	2.263	2.258
Pitch	2.187	2.182
Minor	2.096	2.089

Note: Optional head may have wrench recess 1 1/16" square, 9/16" deep, with 5° tapered sides.

Note: Plug shall be threaded so as to permit meeting of gasket surfaces when assembled, without gasket, in flange.

(i)


FLANGE
7°
7°
Counterbore
1.048" dia
1.043"
125
1/8" R
1/8" R
1/32"
1/8"
Remove burrs
1/32" R max
5°
0.0714"
60°
1/8" +0" −1/64"
0.0476" basic full depth
Numbers to mark AISI type stainless steel
1/8"
1 1/2" ±1/32" dia
2 1/8" +1/16" dia −0"
Break sharp edge
3/32" drill one hole
1/16"
125
9/16" +1/32" −0"
9/32" ±1/32"
9/64" ±1/32"
1 1/2" +1/32" −0"
PLUG
1/8"
5°
Maintain this dia at major thread dia
3/16"
1/4" R
1/4" R
125
Undercut
60°
1/4" R
1/8" R
0.0714"
0.0476" basic full depth
3/8"
3/16" min
3/8"
3/32" drill one hole
3/16" R
Numbers in pocket to mark AISI type stainless steel
1/8"
1 1/2" ± 1/32"
3/32" +0" −1/32"
3/32" +0" −1/64"
30° ± 2°
7/32"
1/4"
1 1/16" +1/32" −0"
125
1 5/16" +1/32" −0"
Undercut 0.048" deep before threading

Threading Specifications
Modified Straight Pipe Thread

3/4" – 14 TPI

	Max (in.)	Min (in.)
Major	1.0432	1.0356
Pitch	0.9956	0.9880
Minor	0.9356	0.9404

Notes: Optional head may have wrench recess 9/16" square, 3/8" deep, with 5° tapered sides.

Threading Specifications
Modified Straight Pipe Thread

3/4" – 14 TPI

	Max (in.)	Min (in.)
Major	1.0306	1.0154
Pitch	0.9830	0.9754
Minor	0.9354	0.9278

Note: Plug shall be threaded so as to permit meeting of gasket surfaces when assembled, without gasket, in flange.

or (2) Eleven and one-half (11½) threads per inch, standard pipe size.

(e) Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66200, Nov. 19, 1979]

§ 178.88-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.88-10 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) DOT-5K.

(2) Name or symbol of person making the marks specified in paragraph (a) (1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5753, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

Note: For citations to additional amendments to § 178.88-10 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.88-11 Size of markings.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 178.88-12 Type tests.

(a) Samples, taken at random and closed as for use, must be capable of withstanding prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 12 months, except as provided in paragraph (a)(3) of this section. Samples last tested to be retained until further tests are made or for 2 years, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test of any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

(3) Periodic drop and hydrostatic tests are not required when container has satisfactorily met prescribed tests at the original start of production. Satisfactory test results must be obtained on samples of subsequent containers that have been altered in design or construction. Samples so tested must be retained until further tests are made or for 2 years, whichever period is shorter.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5753, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.88-13 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66200, Nov. 19, 1979]

§ 178.89 Specification 5L; steel barrels or drums.

Removable head containers not authorized.

§ 178.89-1 Compliance.

(a) Required in all details.

§ 178.89-2 Rated capacity.

(a) Rated capacity as marked, see § 178.89-9(a)(3). Actual capacity shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart.

§ 178.89-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.89-5 Seams.

(a) Body seams welded.

(b) Head and chime seams welded or double-seamed.

(c) Flanged spout for filling and emptying container welded in place or attached in a manner approved by the Associate Director for OE.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66200, Nov. 19, 1979]

§ 178.89-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
					Minimum	
		Body sheet	Head sheet	Type	Size (gauge or inch)	Weight (pounds per foot)
5	Rectangular	20	20	None		

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness[1] (inch)	Minimum thickness[1] (inch)
20	0.0359	0.0324

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

§ 178.89-7 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part must be of sufficient strength to withstand the drop test prescribed in § 178.89-11(a)(1).

(c) Closure must be of screw-thread type or fastened by screw-thread device.

(d) Openings over 2.5 inches diameter not permitted.

§ 178.89-8 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.89-9 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) DOT-5L.

(2) Name or symbol of person making the marks specified in paragraph (a) (1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacturer (for example, 20-5-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 20/18-5-50 for body 20 gauge and head 18 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5753, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For amendments to § 178.89-9 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.89-10 Size of markings.

(a) Size of markings (minimum): ½" high.

§ 178.89-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 15 pounds per square inch sustained for 5 minutes.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5753, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.89-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 5 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66200, Nov. 19, 1979]

§ 178.90 Specification 5M; monel drums.

Removable head containers not authorized.

§ 178.90-1 Compliance.

(a) Required in all details.

§ 178.90-2 Rated capacity.

(a) Rated capacity as marked, see § 178.90-10(a)(3). Actual capacity of containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 178.90-3 Composition.

(a) Material must be, except for rolling hoops and chime reinforcements monel.

§ 178.90-4 Seams.

(a) Body seams welded.

(b) Head and chime seams welded or double-seamed.

(c) Flanges for closures welded in place.

§ 178.90-5 Chime reinforcement.

(a) Containers to have chime reinforcement adequate for its protection.

§ 178.90-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness in the black (gauge, United States Standard)		Rolling hoops		
				Type [1]	Minimum	
		Body sheet	Head sheet		Size (gauge or inch)	Weight (pounds per foot)
10	Straight side	14	14	None		
55	do	14	14	I-bar	¾ × 1¼	1.60

[1] Rolling hoops may be of pliable solid rubber, metal, or other suitable material provided that equivalent protection to drum integrity is afforded.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-36, 39 FR 44990, Dec. 30, 1974, as amended by Amdt. 178-59, 44 FR 66200, Nov. 19, 1979]

§ 178.90-7 Rolling hoops.

(a) Separate hoops if used, to have tight fit on shell and be firmly secured in place. Beading under rolling hoops or spot welding not permitted.

§ 178.90-8 Closures.

(a) Adequate to prevent leakage. Closure must be of screw-thread type or fastened by screw-thread device. Unthreaded cap is authorized for containers of 12 gallons or less if cap is provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

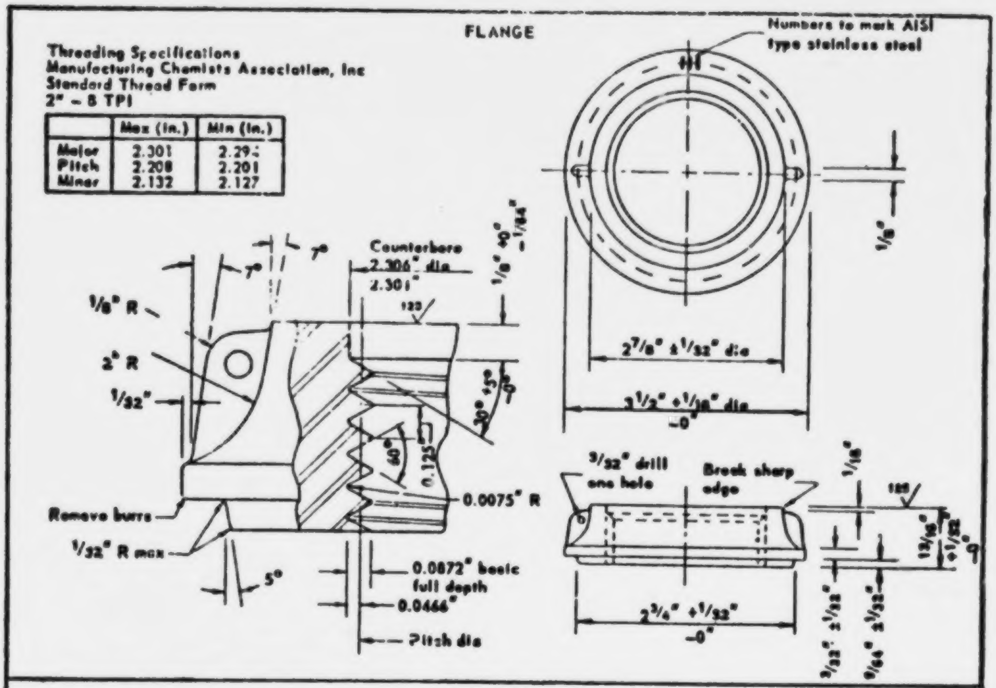
(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug or cap must have 5 or more complete threads; 2 drainage holes of not over 5/16-inch diameter are allowed in that section of flange which extends inside the drum. Plug or cap must have sufficient length of thread to engage 5 threads when securely tightened with gasket in place.

(d) Openings over 2.3 inches diameter are not permitted. Threads for plug or cap must be 8 or less per inch when over ¾-inch standard pipe size.

(1) Flanges with inside threads and plugs must conform with the thread diameter and thread form shown in the following drawing (other details shown on the drawing are recommended):

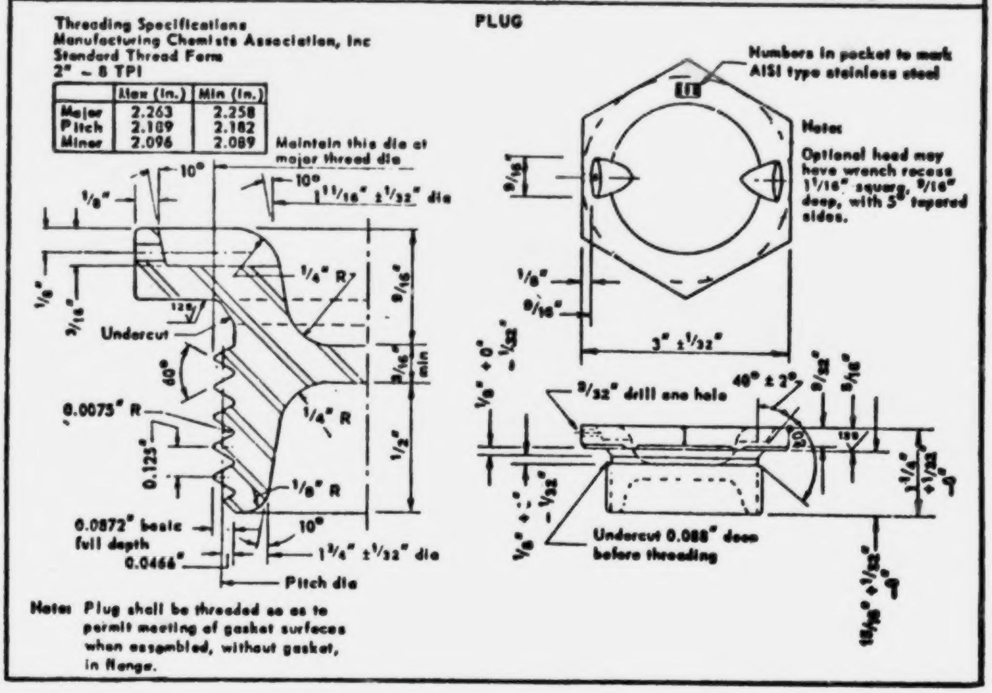


FLANGE

Threading Specifications
Manufacturing Chemists Association, Inc
Standard Thread Form
2" – 8 TPI

	Max (in.)	Min (in.)
Major	2.301	2.294
Pitch	2.208	2.201
Minor	2.132	2.127

7°
7°
Counterbore 2.306" dia / 2.301"
1/16" +0" −1/64"
125
1/8" R
2" R
1/32"
30° +2° −0°
60°
0.125
0.0075" R
Remove burrs
1/32" R max
5°
0.0872" basic full depth
0.0466"
Pitch dia
Numbers to mark AISI type stainless steel
1/8"
2 7/8" ±1/32" dia
3 1/2" +1/16" dia −0"
3/32" drill one hole
Break sharp edge
1/16"
125
13/16" +1/32" −0"
2 3/4" +1/32" −0"
3/32" ±1/32"
9/64" ±1/32"



PLUG

Threading Specifications
Manufacturing Chemists Association, Inc
Standard Thread Form
2" – 8 TPI

	Max (in.)	Min (in.)
Major	2.263	2.258
Pitch	2.189	2.182
Minor	2.096	2.089

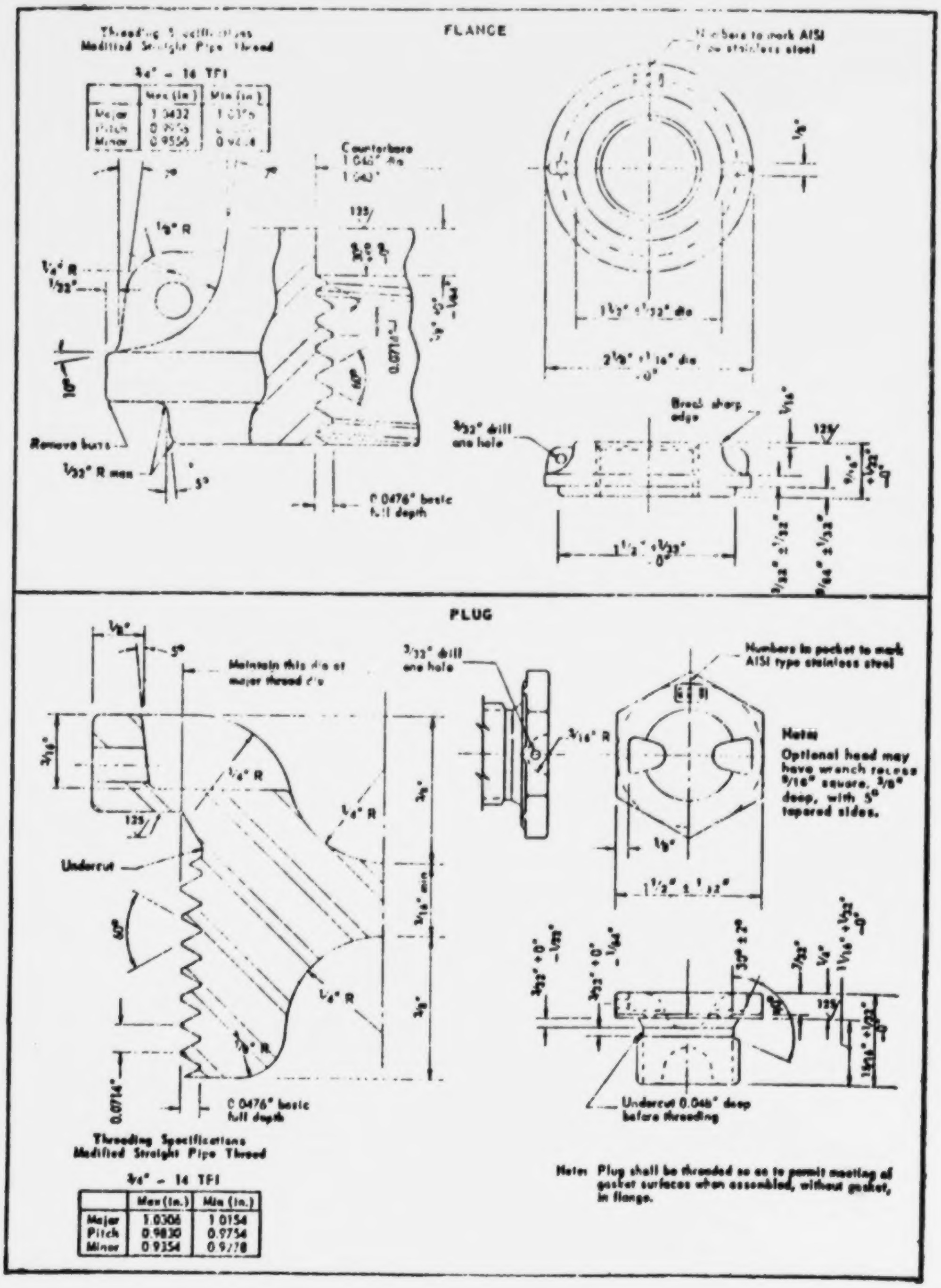
Maintain this dia at major thread dia
10°
1/8"
10°
1 11/16" ±1/32" dia
1/8"
3/16"
125
Undercut
1/4" R
9/16"
3/16" min
40°
0.0075" R
1/4" R
0.125"
1/2"
1/8" R
0.0872" basic full depth
0.0466"
10°
1 3/4" ±1/32" dia
Pitch dia
Numbers in pocket to mark AISI type stainless steel
9/16"
1/8"
9/16"
3" ±1/32"
1/8" +0" −1/32"
3/32" drill one hole
40° ± 2°
9/32"
5/16"
125
40°
1 1/4" +1/32" −0"
1/8" +0" −1/32"
Undercut 0.088" deep before threading
15/16" +1/32" −0"

Note:

Optional head may have wrench recess 1 1/16" square, 9/16" deep, with 5° tapered sides.

Note: Plug shall be threaded so as to permit meeting of gasket surfaces when assembled, without gasket, in flange.

(i)


FLANGE
Numbers to mark AISI type stainless steel
Counterbore 1.045" dia 1.043"
7°
7°
1/8" R
1/4" R
1/32"
10°
Remove burrs
1/32" R max
5°
125
0.0714"
60°
0.0476" basic full depth
1/8"
1 1/2" +1/32" dia
2 1/8" +1/16" dia -0"
Break sharp edge
3/32" drill one hole
1/16"
125
1 1/2" +1/32" -0"
3/32" ±1/32"
9/64" ±1/32"
PLUG
1/8"
5°
Maintain this dia at major thread dia
3/16"
1/4" R
1/4" R
125
Undercut
60°
1/4" R
1/8" R
0.0714"
0.0476" basic full depth
3/8"
3/16" min
3/8"
3/32" drill one hole
3/16" R
Numbers in pocket to mark AISI type stainless steel
1/8"
1 1/2" ±1/32"
3/32" +0" -1/32"
3/32" +0" -1/64"
30° ±2°
3/32"
1/4"
1 1/16" +1/32" -0"
125
45°
1 5/16" +1/32" -0"
Undercut 0.046" deep before threading

Threading Specifications
Modified Straight Pipe Thread

3/4" – 14 TPI

	Max (in.)	Min (in.)
Major	1.0432	[illegible]
Pitch	[illegible]	[illegible]
Minor	0.9556	[illegible]

Threading Specifications
Modified Straight Pipe Thread

3/4" – 14 TPI

	Max (in.)	Min (in.)
Major	1.0306	1.0154
Pitch	0.9830	0.9754
Minor	0.9354	0.9278

Note: Optional head may have wrench recess 9/16" square, 3/8" deep, with 5° tapered sides.

Note: Plug shall be threaded so as to permit meeting of gasket surfaces when assembled, without gasket, in flange.

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or (2) Eleven and one-half (11½) threads per inch, standard pipe size.

(e) Other types of closures are authorized if they perform without failure under the test required by this section and a record of the tests is retained during the period the closure is in use.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66200, Nov. 19, 1979]

§ 178.90-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.90-10 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) DOT-5M.

(2) Name or symbol of person making the marks specified in paragraph (a) (1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5753, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.90-10 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.90-11 Size of markings.

(a) Size of marking (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons.

§ 178.90-12 Type tests.

(a) Samples taken at random and closed as for use, must be capable of withstanding prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 12 months, except as provided in paragraph (a)(3) of this section. Samples last tested to be retained until further tests are made or for 2 years, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

(3) Periodic drop and hydrostatic tests are not required where container has satisfactorily met prescribed tests at the original start of production. Satisfactory test results must be obtained on samples of subsequent containers that have been altered in design or construction. Samples so tested must be retained until further tests are made or for 2 years, whichever period is shorter.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5753, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.90-13 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66200, Nov. 19, 1979]

§ 178.92 Specification 5P; lagged steel drums.

Removable head containers not authorized.

§ 178.92-1 Compliance.

(a) Required in all details.

§ 178.92-2 Rated capacity.

(a) Rated capacity not over 61 gallons, see § 178.92-12(a)(3). Actual capacity shall be not less than rated capacity plus two percent nor greater than rated capacity plus two percent plus one and one-half gallons.

§ 178.92-3 Composition.

(a) Sheets for body and heads of inside container to be low carbon or austenitic stainless, open hearth or electric steel. Sheets for body and heads of outside shell may be of any weldable steel suitable for the purpose.

§ 178.92-5 Construction.

(a) Container shall consist of a straight sided inside steel drum which must be lagged with a suitable fire-resistant lagging material of such insulating properties and thickness that the drum charged with the commodity to be shipped will not rupture in a fire when it is equipped with safety devices as required by § 178.92-9. The entire insulation must be covered with a metal shell so constructed that moisture cannot come in contact with lagging.

(b) Brazing is not permitted.

(c) All seams of drum and shell must be fusion welded.

(d) Flanges or bosses for closures in the inner container must be fusion welded in place to the inside drum and the metal shell.

(e) Means for testing inside drum for leaks must be provided in outside shell.

§ 178.92-6 Parts and dimensions.

(a) Parts and dimensions as follows:

(1) Steel sheets used for body and head sheets for inside drum must have nominal thickness of at least 0.0747 inch and minimum thickness of 0.0677 inch, uncoated sheets, which shall be designated 14 gauge.

(2) Steel sheets used for body sheets for outside shell must have nominal thickness of at least 0.1046 inch and minimum thickness of 0.0946 inch, uncoated sheets, which shall be designated 12 gauge.

(3) Steel sheets used for head sheets for outside shell must have nominal thickness of at least 0.0747 inch and minimum thickness of 0.0677 inch, uncoated sheets, which shall be designated 12 gauge.

§ 178.92-7 Rolling hoops.

(a) Rolling hoops are required and these may be rolled or swedged in the outside shell or consist of separate hoops having a tight fit on shell and securely held in place.

§ 178.92-8 Closures.

(a) All closures must be of screw-thread type adequate to prevent leakage and be of a material which will not react dangerously in contact with the commodity.

(b) All openings in inside drums must be located in the top head.

(c) Openings over 2.3 inches screw thread size not permitted.

(d) Plugs, caps, or other fittings must have sufficient length of thread to engage 5 threads when screwed home with gasket in place.

(e) Gaskets which are not affected by lading are required for closures having straight threads.

§ 178.92-9 Safety devices.

(a) Each drum must have safety devices approved as to type and location by the Associate Director for OE. See § 173.124 (a)(4) of this subchapter.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66200, Nov. 19, 1979]

§ 178.92-10 Closure protection.

(a) Construction must be such as to afford adequate protection to valves and safety devices.

§ 178.92-11 Defective containers.

(a) Leaks and other defects to be repaired only by processes used in constructing container.

§ 178.92-12 Marking.

(a) Marking on each container by embossing with raised marks or by steel stamping on top head of outside shell or on a permanently attached head protective ring, as follows:

(1) DOT-5P.

(2) Name or symbol of person making the marks specified in para-

graph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Minimum gauge of metal of inner container, rated capacity in gallons and year of manufacture must be indicated in the order named (for example, 14-61-50).

(4) Size of markings (minimum): ½ inch high for stamping, 1 inch high for embossing.

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.92-13 Tests.

(a) Sample drums, taken at random and closed as for use, shall withstand prescribed tests without leakage, one test to be made of each design and size of drum by each company before starting production as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet on to solid concrete so as to strike diagonally on chime (foot ring), or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker.

(2) Hydrostatic pressure test of 100 pounds per square inch sustained for five minutes. This test shall be applied to the finished inner container before lagging material and outer shell are assembled.

(3) Samples last tested to be retained until further tests are made.

§ 178.92-14 Leakage test.

(a) Each container shall be subjected to a pressure test of at least 125 pounds per square inch sustained for at least 30 seconds. Test shall be applied to inner container before lagging material or outer shell is assembled. Failures shall be rejected or repaired and retested.

NOTE 1: If air or other gas is the pressurizing medium, the test should be conducted in a pit or equivalent means of safeguarding personnel.

(b) Subsequent to the test specified in paragraph (a) of this section each container shall be tested with seams under water or covered with soapsuds or other suitable material by interior air pressure of at least 75 pounds per square inch. Leakage test shall be applied to finished inner container before lagging or outer shell is assembled. Leakers shall be rejected or repaired and retested.

§ 178.98 Specification 6B; steel barrels or drums.

Removable head containers which will pass all required tests are authorized.

§ 178.98-1 Compliance.

(a) Required in all details.

§ 178.98-2 Rated capacity.

(a) Rated capacity as marked, see § 178.98-9(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent, plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 178.98-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.98-5 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Authorized gross weight (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
					Type [1]	Minimum	
			Body sheet	Head sheet		Size (gauge or inch)	Weight (pounds per foot)
5 to 10	160	Straight side	18	18	None		
5 to 30	480	do	16	16	U [1]	14	

Marked capacity not over (gallons)	Authorized gross weight (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
			Body sheet	Head sheet	Type [1]	Minimum	
						Size (gauge or inch)	Weight (pounds per foot)
5 to 55	880	......do	14	14	U	12	
5 to 30	480	......do	16	16	I-bar [1]	¾ × 1¼	1.25
5 to 55	880	......do	14	14	......do	¾ × 1¼	1.25
5 to 110	1,760	......do	12	12	I-Bar	¾ × 1¼	1.60
5 to 33	480	Bilge	15	16	None		
5 to 55	880	......do	13	14	......do		

[1] Rolled or swedged in hoops permitted.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
12	0.1046	0.0946
13	.0897	.0817
14	.0747	.0677
15	.0673	.0603
16	.0598	.0533
18	.0478	.0428

[1] Thickness shall be measured at any point on the sheet less than ⅜ inch from an edge.

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–36, 39 FR 44990, Dec. 30, 1974]

§ 178.98–6 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops not permitted. Attachment to drum body by spot welding, except for continuous resistance method, not permitted. Welding of I-bar type directly to body of drum in any manner not permitted.

§ 178.98–7 Closures.

(a) Adequate to prevent leakage; gaskets required. Closures must be of screw-thread type or secured by positive fastening.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

§ 178.98–8 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.98–9 Marking.

(a) Marking on each container by embossing on head, except that such embossment, must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) DOT-6B * * *; stars to be replaced by the authorized gross weight (for example, DOT-6B880, etc.). In addition, when the container is of stainless steel, the type of steel used in body and head sheets, as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, DOT-6B880-304 or DOT-6B880-304 HT as applicable), shall be shown.

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indi-

cated with slanting line between and with gauge of body indicated first (for example, 14/12-55-50 for body 14 gauge and head 12 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5754, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.98-9 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.98-10 Size of markings.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 178.98-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with dry, finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diagonally on top chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops, must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 30 pounds per square inch sustained for 5 minutes. Leakage through closure shall not constitute failure.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5754, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.98-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure. Removable head containers need not be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every 4 months. Samples last tested must be retained until further tests are made or for 1 year.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66200, Nov. 19, 1979]

§ 178.99 Specification 6C; steel barrels or drums.

Removable head containers which will pass all required tests are authorized.

§ 178.99-1 Compliance.

(a) Required in all details.

§ 178.99-2 Rated capacity.

(a) Rated capacity as marked, see § 178.99-9(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 178.99-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.99-5 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Authorized gross weight (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
			Body sheet	Head sheet	Type	Minimum	
						Size (gauge or inch)	Weight (pounds per foot)
5	80	Straight side	22	22	None		
5 to 10	160	......do	20	20	......do		
5 to 30	480	......do	18	18	U	16	
5 to 55	880	......do	16	16	U	14	
5 to 110	1,760	......do	14	14	U	12	
5 to 30	480	......do	18	18	I-bar	¾ × 1¼	1.25
5 to 55	880	......do	16	16	......do	¾ × 1¼	1.25
5 to 110	1,760	......do	14	14	I-bar	¾ × 1¼	1.60
5 to 33	480	Bilge	16	18	None		
5 to 55	880	......do	15	16	......do		

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness[1] (inch)	Minimum thickness[1] (inch)
14	0.0747	0.0677
15	.0673	.0603
16	.0598	.0533
18	.0478	.0428
20	.0359	.0324
22	.0299	.0269

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-36, 39 FR 44990, Dec. 30, 1974]

§ 178.99-6 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops not permitted. Attachment to drum body by spot welding except for continuous resistance method, not permitted. Welding of I-bar type directly to body of drum in any manner not permitted.

§ 178.99-7 Closures.

(a) Adequate to prevent leakage; gaskets required. Closures must be of screw-thread type or secured by positive fastening.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used it must be provided with outside sealing device which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

§ 178.99-8 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.99-9 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head of drums having removable heads, with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) DOT-6C * * *; stars to be replaced by the authorized gross weight (for example, DOT-6C880, etc.). In addition, when the container is of stainless steel, the type of steel used in body and head sheets, as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, DOT-6C880-304 or DOT-6C880-304 HT as applicable) shall be shown.

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5754, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.99-9 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.99-10 Size of markings.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons, and 1" for over 55 gallons.

§ 178.99-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with dry, finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diagonally on top chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 30 pounds per square inch sustained for 5 minutes. Leakage through closure shall not constitute failure.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5754, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.99-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure. Removable head containers need not be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every 4 months. Samples last tested must be retained until further tests are made or for 1 year.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66201, Nov. 19, 1979]

§ 178.100 Specification 6J; steel barrels and drums.

Removable head containers which will pass all required tests are authorized.

§ 178.100-1 Compliance.

(a) Required in all details.

§ 178.100-2 Rated capacity.

(a) Rated capacity as marked, see § 178.100-9(a)(3). Actual capacity of straight-sided containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts; actual capacity of bilge-type containers must be not less than rated capacity, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 178.100-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.100-5 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Authorized gross weight (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
			Body sheet	Head sheet	Type [1]	Minimum	
						Size (gauge or inch)	Weight (pounds per foot)
5 to 30	260	Straight side	19	19	([1])		
5 to 55	480	......do	18	18	([1])		
5 to 55	880	......do	16	16	U	14	
5 to 55	880	......do	16	16	I-bar	¾ × 1¼	1.25
5 to 33	480	Bilge	16	18	None		
5 to 55	880	......do	15	16	......do		

[1] Rolled or swedged-in hoops.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
15	0.0673	0.0603
16	.0598	.0533
18	.0478	.0428
19	.0418	.0378

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

§ 178.100-6 Rolling hoops.

(a) Separate hoops to have tight fit on shell and be firmly secured in place. Beading under rolling hoops not permitted. Attachment to drum body by spot welding except for continuous resistance method, not permitted. Welding of I-bar type directly to body of drum in any manner not permitted.

§ 178.100-7 Closures.

(a) Adequate to prevent leakage; gaskets required. Closures must be of screw-thread type or secured by positive fastening.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used, it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

§ 178.100-8 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.100-9 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) DOT-6J * * *; stars to be replaced by the authorized gross weight (for example, DOT-6J880, etc.). In addition, when the container is of stainless steel, the type of steel used in body and head sheets, as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress relieving or heat treatment during manufacture (for example, DOT-6J880-304 or DOT-6J880-304 HT as applicable), shall be shown.

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for

example, 14/12-55-50 for body 14 gauge and head 12 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5754, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.100-9 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.100-10 Size of markings.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons.

§ 178.100-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with dry finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diagonally on top chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5754, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.102 Specification 6D; cylindrical steel overpack, straight sided, for inside plastic container.

§ 178.102-1 Material requirements.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.102-2 Construction requirements.

(a) Construction requirements are as follows:

Rated capacity of inside plastic container not over (gallons)	Minimum thickness, uncoated sheets (gauge)		Body seems	Rolling hoops	Top or bottom head	Closures, when full removable head is used (gaskets not required)
	Body sheet	Head sheet				
5	24	24	Welded	None required	Double seamed or welded.	Lug or plain ring seal.
15	20	20	do	Rolled or swedged	do	Do.
30	19	19	do	do	do	Bolted type ring closure, 18 gauge.
55	18	18	do	Rolled or swedged, or I-Bars, ¾" × ¼".	do	Bolted type ring closure, 16 gauge.

(b) Steel sheets or parts of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
16	0.0598	0.0533
18	.0478	.0428
19	.0418	.0378
20	.0359	.0324
24	.0239	.0209

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

(c) Two holes not exceeding ¼ inch each are permitted diametrically opposite each other in the overpack body immediately above the double seam of the bottom chime or three holes not exceeding ³⁄₁₆ inch in diameter on centers 120 degrees apart in the bottom head.

(1) Overpack interior shall be free of projections, burrs, or any edges that might cause damage to inside plastic container and shall be free of lubricants, oils, or any foreign matter.

(2) Top head may have not more than two holes of suitable size to provide for protruding closures.

(3) Overpack shall be constructed to provide a snug fit for inside plastic container.

§ 178.102-3 Tests.

(a) Steel overpack when assembled as for use, shall withstand the tests prescribed in specifications for inside plastic containers as detailed in Part 178 when authorized as combination packages in Part 173 of this chapter. The completed package must withstand these tests without producing a condition of the overpack that could result in potential damage to the inside container.

§ 178.102-4 Markings.

(a) Marking on each container by embossing on bottom head with raised marks with letters and figures not less than ½ inch high as follows:

(1) DOT-6D.

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity of inside container in gallons, and year of manufacture (for example, 18-55-62). When gauge of metal in body differs from that in either head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 18/16-55-62 for body 18 gauge and head 16 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5755, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For amendments to § 178.102-4 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.103 Specification 6L; metal packaging.

[Amdt. 178-35, 39 FR 45246, Dec. 31, 1974]

§ 178.103-1 General requirements.

Each packaging must meet the applicable requirements of § 173.24 of this subchapter.

[Amdt. 178-35, 39 FR 45246. Dec. 31, 1974]

§ 178.103-2 Rated capacity.

(a) Rated capacity as marked (see § 178.103-6). Not less than 55 gallons nor more than 110 gallons for the outer steel drum. Not more than 17.74 liters for the inner vessel.

(b) The authorized maximum gross weight of the package is 160 kilograms (350 pounds) for sizes not over 210L (55 gallons) or 220 kilograms (480 pounds) for sizes over 210L (55 gallons) but not over 420L (110 gallons).

[Amdt. 178-1, 33 FR 14934, Oct. 4, 1968, as amended by Amdt. 178-35, 39 FR 45246, Dec. 31, 1974]

§ 178.103-3 General construction requirements.

(a) The outer shell must be of straight sided steel, with welded body seams and at least 18-gauge body and bottom head sheets, and 14-gauge removable head sheets (unless there are one or more corrugations in the cover near the periphery, in which case 16-gauge is authorized). The shell may be either a single sheet of steel or may be fabricated by welding together two appropriate lengths of 210L (55-gallon) drums, such as a DOT Specification 6J or 17H, with rolled or swedged in hoops as prescribed for either of those specifications. The head must be convex (crowned), not extending beyond the level of the chime, with a minimum convexity of 1 centimeter (⅜-inch). The inside diameter of the shell must be at least 57 centimeters (22.5 inches).

(b) Inner containment vessel must conform to specification 2R (except that cast iron is not authorized), with a maximum usable inside dimension of 13.3 centimeters (5.25 inches) maximum height of 127 centimeters (50 inches) (with caps in place) and minimum wall thickness of 6 millimeters (0.25 inch).

(c) Inner containment vessel must be fixed within the outer shell by one of the following types of centering devices:

(1) At least 8 steel rod spacers, of at least 6 millimeters (0.25-inch) diameter (for packages of 210 liters (55-gallon) capacity) or 1 centimeter of (0.375-inch) diameter (for packages with greater than 210 liters (55-gallon)

capacity) cold rolled steel, welded to the vessel at each end by minimum 5 centimeter (2-inch) continuous weld. Each rod must be welded to the vessel at radial positions not exceeding 45 degrees as not to interfere with closure of the inner vessel. Each spacer rod must extend at least 5.6 centimeters (2.25 inches) beyond the inner vessel at each end, then radially to the wall of the outer drum (to provide a spring-like snug fit) and along the entire length of the wall of the outer drum. For a packaging of more than 210 liters (55-gallon) capacity, each spacer rod must be braced by welding a 6 millimeter (0.25-inch) by 5 centimeter (2-inch) steel plate to the spacer rod and the pipe with a continuous weld at each joint, the joints being located approximately half way along the length of the drum. For containers manufactured prior to March 31, 1975, this requirement is effective December 31, 1975.

(2) At least three steel "spiders," not more than 24 inches apart, with each spider having at least four legs. Each leg must be constructed of materials having dimensions not less than those listed in this paragraph, welded by continuous weld at each joint to inner and outer steel bands of at least ¼-inch by 1-inch steel. The inner steel band must be welded to the inner vessel by at least six 2-inch welds on both edges of the band. The outer steel band must be welded to the outer drum by at least six 2-inch welds on both edges of the top outer band, such that the inner vessel is at least 2¼ inches from the top and bottom of the drum. Authorized construction materials are:

(i) 2.5 centimeters (1 inch) by 2.5 centimeters (1 inch) by 6 millimeters (¼-inch) steel angle iron.

(ii) 3 centimeters (1¼ inches) by 3 centimeters (1¼ inches) by 5 millimeters (3/16-inch) steel angle iron.

(iii) 2.5 centimeters (1 inch) schedule 40 steel pipe.

(iv) 1½-inch diameter solid steel rods, with only two such spiders required instead of three.

(3) There must not be less than 2 spacer mechanisms for a packaging of 210 liters (55-gallon) capacity nor less than 3 spacer mechanisms for a packaging greater than 210 liters (55-gallon) capacity. Each spacer mechanism must consist of not less than 6 steel angles, pipe, or rod radial supports of at least 2.7 square centimeters (0.42 square inch) cross-section. Each radial support must be welded at one end to the containment vessel by a continuous weld or to an inner steel band of at least 6 millimeters (¼-inch) by 2.5 centimeters (1 inch) by a continuous weld at radial positions not exceeding 60 degress from the center of the package. The inner band, when used, must be welded to the inner containment vessel by at least 6 equally spaced 5 centimeter (2-inch) welds on each edge of the band. The opposite end of the radial support must be welded by a continuous weld to an outer steel band of at least 6 millimeters (¼-inch) by 2.5 centimeters (1 inch). The outer steel band must be welded to the outer shell by at least 6 equally spaced welds on each edge of the top band, such that the inner vessel is fixed at least 5.7 centimeters (2.25 inches) from the top and bottom of the drum. The spacer mechanism must be welded as specified near each end of the containment vessel so as not to interfere with the vessel closure. For a packaging greater than 210L (55-gallon) capacity, the additional spacer mechanism must be located at approximately midpoint along the length of the inner vessel.

(d) The void between the inner containment vessel and the outer shell must be completely filled with bagged or tamped vermiculite (expanded mica), with a density of at least 0.072 g/cc (4.5 pounds per cubic foot). Loose, untamped vermiculite is not authorized.

[Amdt. 178-1, 33 FR 14934, Oct. 4, 1968, as amended by Amdt. 178-35, 39 FR 45246, Dec. 31, 1974; 40 FR 2435, Jan. 13, 1975; 40 FR 44327, Sept. 26, 1975]

§ 178.103-4 Welding.

Welding must be of material having a melting point in excess of 800° C (1475° F) (except that for packages constructed prior to March 31, 1975, this temperature may be 540° C (1000° F)), with a joint efficiency of at least 0.85. This requirement applies to welding used in adding spacer rods to comply with 178.103(3)(c)(1).

[Amdt. 178-35, 39 FR 45246, Dec. 31, 1974]

§ 178.103-5 Closure.

(a) The outer drum closure must be at least a 12-gauge bolted ring with drop forged lugs, one of which is threaded, and having at least a 1.6 centimeter (⅝-inch) diameter steel bolt and a lock nut, or equivalent device.

(b) The closure device must have a means for the attachment of a tamper-proof lock wire and seal, or equivalent.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968, as amended by Amdt. 178-35, 39 FR 45246, Dec. 31, 1974]

§ 178.103-6 Markings.

(a) Markings on each container, by die stamping on a metal plate attached to the outside of the outer container by spot welding, or other equally efficient method, in letters and figures of at least one-fourth inch in height, as follows:

(1) "DOT-6L".

(2) "FISSILE RADIOACTIVE MATERIAL."

(3) Name or symbol of person making the marks specified in paragraph (a) (1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(4) Gauge of metal of the outer steel drum in the thinnest part, rated capacity of the outer steel drum in gallons, and the year of manufacture of the assembled package (e.g., 18-110-68). When the gauge of the metal in the drum wall differs from that in the head, both must be indicated with a slanting line between, and with the gauge of the body indicated first (e.g., 18/16-110-68 for 18-gauge body and 16-gauge head).

[Order 70, 31 FR 6496, Apr. 29, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

Note: For citations to additional amendments to § 178.103-6 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.104 Specification 6M; metal packaging.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968]

§ 178.104-1 General requirements.

(a) Each package must meet the applicable requirements of § 173.24 of this chapter.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968]

§ 178.104-2 Rated capacity.

(a) Rated capacity as marked (see § 178.104-5). Not less than 10 gallons nor more than 110 gallons for the outer steel drum. Not less than 1.24 liters for the inner containment vessel.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968]

§ 178.104-3 General construction requirements.

(a) The outer shell must be of straight-sided steel, with welded body seams, and may be either a single sheet of steel, or may be fabricated by welding together two appropriate lengths of drums, such as a DOT Specification 6C or 17C, with each length to contain 3 swedged or rolled rolling hoops as prescribed for either of these specifications. A removable head for a packaging of 210 liters (55 gallons) or larger volume must have one or more corrugations in the cover near the periphery. For a packaging exceeding 57 liters (15 gallons) volume, the head must be crowned (convexed), not extending beyond the level of the chime, with a minimum convexity of 1 centimeter (⅜-inch).

(1) The maximum authorized gross weight, metal thickness, and minimum end insulation thickness for the marked volume is as follows:

Marked capacity		Maximum authorized gross weight		Minimum thickness of uncoated sheets and heads (gauge)	Minimum thickness of end insulation	Centimeters
Gallons not over	Liters	Pounds	Kilograms		Inches	
15	57	160	73	20	1.88	4.7
30	114	480	219	18	3.75	9.5
55	210	640	292	16	3.75	9.5
110	420	640	292	16	3.75	9.5

(2) Each drum must have at least four 1.2 centimeter (0.5-inch) diameter vents near the top, each covered with a weatherproof tape or fusible plug; or equivalent device. A layer of porous refractory fiber may be placed behind the pressure-relief vent holes.

(b) Inner containment vessel must conform to specification 2R or equivalent (cast iron or brass are prohibited), with maximum usable inside diameter of 13.3 centimeters (5.25 inches), minimum usable inside diameter of 10 centimeters (4 inches), and minimum height of 15 centimeters (6 inches).

(c) Inner containment vessel must be fixed within the outer shell by one of the following types of solid centering media, with the sides of the inner vessel protected by at least 9.5 centimeters (3.75 inches) of insulation media, and the ends with at least the thickness as prescribed in § 178.104-3(a)(1).

(1) Machined discs and rings made of solid industrial cane fiberboard having a density of at least 0.24 g/cc (15 pounds per cubic foot) fitted such that the radial clearances between the fiberboard, inner vessel, and shell do not exceed 6 millimeters (¼-inch); or

(2) Hardwood or plywood at least 1.2 centimeter (½-inch) thick, having a density of at least 0.45 g/cc (28 pounds per cubic foot). There must be no gap or direct heat path from the shell to the inner vessel.

(d) Any radiation shielding material used must be placed within the inner containment vessel or must be protected in all directions by at least the thickness of the thermal insulating material prescribed in paragraph (a) of this section.

(e) For a packaging having an authorized gross weight in excess of 219 kg (480 pounds), a steel bearing plate, at least 6 millimeters (0.25-inch) thick or a plywood disc, at least 2.5 centimeters (1-inch) thick, and at least 25 centimeters (10 inches) in diameter must be provided at both ends and adjacent to the specification 2R inner containment vessel, to provide additional load-bearing surface against the insulation-centering medium.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968, as amended by Amdt. 178-35, 39 FR 45246, Dec. 31, 1974; 40 FR 44327, Sept. 26, 1975]

§ 178.104-4 Closure.

(a) The outer drum closure must be at least 16-gauge bolt-type locking ring having at least a 5/16-inch steel bolt for drum sizes not over 15 gallons, or a 12-gauge bolted ring with drop-forged lugs, one of which is threaded, and a 5/8-inch steel bolt for drum sizes over 15 gallons. Each bolt must be provided with a lock nut or equivalent device.

(b) The closure device must have means for the attachment of a temperproof lock wire and seal, or equivalent.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968]

§ 178.104-5 Markings.

(a) Marking must be as prescribed in § 173.24 of this chapter.

(b) Marking on the outside of each package must be as follows: "DOT-6M Type B," "Radioactive Materials," or "Fissile Radioactive Materials," as appropriate; and the gauge of metal of the outer drum in the thinnest part, rated capacity of the outer drum in gallons, and year of manufacture (for example, 18-30-69). When the gauge of the metal in the drum wall differs from that in the head, both must be indicated with a slanting line between, and with the gauge of the body indicated first (e.g., 18/16-55-69 for 18-gauge body and 16-gauge head).

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968]

§ 178.107 Specification 42B; aluminum drums.

§ 178.107-1 Compliance.

(a) Required in all details.

§ 178.107-2 Rated capacity.

(a) Rated capacity as marked, see § 178.107-9(a)(3). Not less than 5 gallons; actual capacity shall be rated capacity plus at least 2 percent.

§ 178.107-3 Composition.

(a) Body and heads of aluminum at least 99 percent pure, or an aluminum base alloy of equivalent corrosion resistance and physical properties.

§ 178.107-4 Outage.

(a) Two percent of rated capacity, plus a maximum tolerance of 1 quart.

§ 178.107-5 Seams.

(a) Welded, including attachment of flanges for closures and other devices. Circumferential seams at least 3" from top of chime; chime seams not permitted.

§ 178.107-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Minimum thickness of material (inch)	Rolling hoops required, type authorized, and minimum dimensions	
		I-bar, size (inch)	U-type, aluminum, thickness (inch)
10	0.110	¾ x 1¼	0.129
30	154	¾ x 1¼	.193
55	187	¾ x 1¼	.234
110	230	¼ x 1¼	

(b) Rolling hoops must be firmly secured in place and not over 19 inches apart; beading under hoops not permitted. If welding is employed, the welding must be continuous on each edge of hoop.

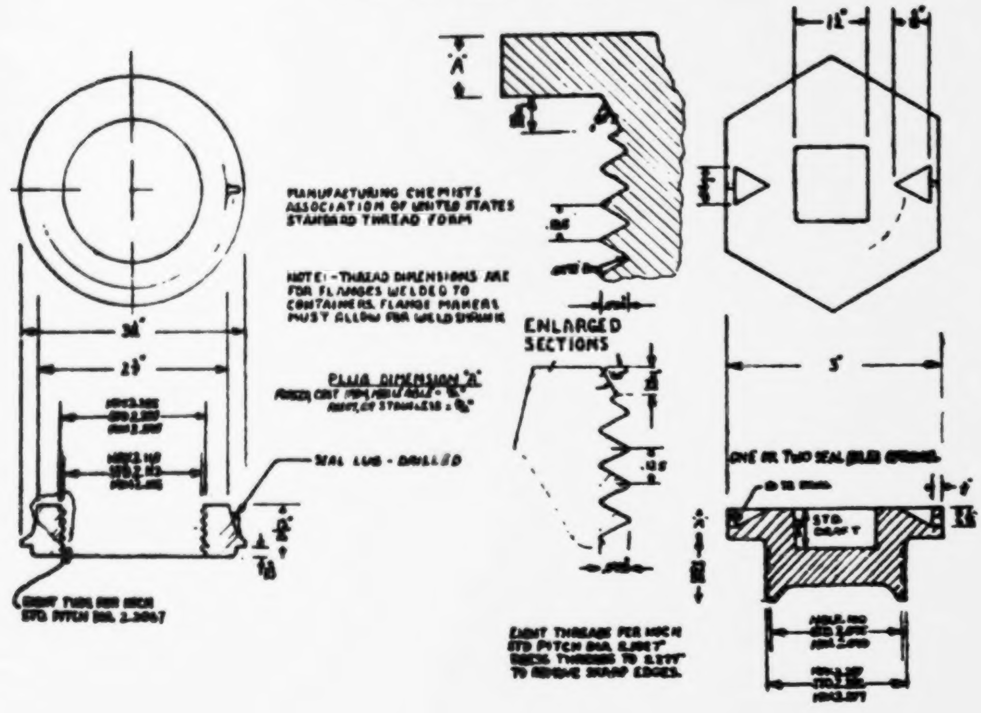
[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-36, 39 FR 44990, Dec. 30, 1974]

§ 178.107-7 Closures.

(a) Of screw-thread type or secured by screw-thread device; openings over 2.3" not authorized; suitable gaskets required.

(b) Threaded plugs, or caps, and flanges must be close fitting with gasket surfaces which bear squarely on each other when without gasket; they must have not over 8 threads per inch, with 5 complete threads engaged when gasket is in place, or not over 4 threads per inch, with 2 complete threads similarly engaged; two $^5/_{16}$ inch drainage holes are authorized in flange. Thread form must conform to that shown by drawing below or be of a form that shall provide an equally efficient closure.

FLANGE AND PLUG


MANUFACTURING CHEMISTS ASSOCIATION OF UNITED STATES STANDARD THREAD FORM
NOTE:-THREAD DIMENSIONS ARE FOR FLANGES WELDED TO CONTAINERS. FLANGE MAKERS MUST ALLOW FOR WELD SHRINK
ENLARGED SECTIONS
PLUG DIMENSION "A"
SEAL LUG - DRILLED
ONE OR TWO SEAL HOLES DRILLED
STD. DRAFT
EIGHT THREADS PER INCH
5"

§ 178.107-8 Projections.

(a) Closing devices and other parts must not project beyond chime or rolling hoops.

§ 178.107-9 Marking.

(a) Marking on each container on top head by stamping with pressure dies, by embossing with raised marks, or plate attached by welding, as follows:

(1) DOT-42B.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal, Brown and Sharpe or equivalent decimal thickness in inches, at start of fabrication; rated capacity in gallons; year of manufacture (for example, 7-30-50 or 0.1442-30-50).

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.107-10 Size of marking.

(a) Size of marking (minimum): ½" high for 30-gallon and smaller containers, ¾" for over 30 and not over 55 gallons, and 1" for over 55 gallons.

§ 178.107-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also addi-

tional test on any other parts which might be considered weaker than the chime.

(2) Hydrostatic pressure test of 60 pounds per square inch sustained for 5 minutes.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5755, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.107-12 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66201, Nov. 19, 1979]

§ 178.107-13 Defective containers.

(a) Leaks and other defects shall be repaired by welding, using welding material of the same composition as originally used by the manufacturer of the drum or other approved aluminum base alloy of equal corrosion and strength qualities.

§ 178.109 Specification 42D; aluminum drums.

§ 178.109-1 Compliance.

(a) Required in all details.

§ 178.109-2 Rated capacity.

(a) Rated capacity as marked, see § 178.109-9(a)(3). Not less than 5 gallons; actual capacity shall be rated capacity plus at least 2 percent.

§ 178.109-3 Composition.

(a) Body and heads of aluminum at least 99 percent pure, or an aluminum base alloy of equivalent corrosion resistance and physical properties.

§ 178.109-4 Outage.

(a) Two percent of rated capacity, plus a maximum tolerance of 1 quart.

§ 178.109-5 Seams.

(a) Welded, including attachment of flanges for closures and other devices. Circumferential seams at least 3" from top of chime; chime seams not permitted.

§ 178.109-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Minimum thickness of material (inch)	Rolling hoops required, type authorized, and minimum dimensions	
		I-bar, size (inch)	U-type, aluminum, thickness (inch)
10	0.093	¾ × 1¼	0.092
30	.102	¾ × 1¼	.128
55	.123	¾ × 1¼	.154
110	.154	¾ × 1¼	

(b) Rolling hoops must be firmly secured in place and not over 19 inches apart; beading under hoops not permitted. If welding is employed, the welding must be continuous on each edge of hoop.

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-36, 39 FR 44990, Dec. 30, 1974]

§ 178.109-7 Closures.

(a) Of screw-thread type or secured by screw-thread device; openings over 2.3 inches not authorized; suitable gaskets required. Vented closing devices must be approved by the Associate Director for OE.

(b) Threaded plugs, or caps, and flanges must be close fitting with gasket surfaces which bear squarely on each other when without gasket; they must have not over 8 threads per inch, with 5 complete threads engaged when gasket is in place, or not over 4 threads per inch, with 2 complete threads similarly engaged; two ⁵⁄₁₆ inch drainage holes are authorized in flange. Thread form must conform to that shown by drawing in paragraph (b) of § 178.107-7 or be of a form that shall provide an equally efficient closure.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66201, Nov. 19, 1979]

§ 178.109-8 Projections.

(a) Closing devices and other parts must not project beyond chime or rolling hoops.

§ 178.109-9 Marking.

(a) Marking on each container on top head, by stamping with pressure dies, by embossing with raised marks, or plate attached by welding, as follows:

(1) DOT-42D.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal, Brown and Sharpe or equivalent decimal thickness in inches, at start of fabrication; rated capacity in gallons; year of manufacture (for example, 7-30-50 or 0.1442-30-50).

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.109-10 Size of marking.

(a) Size of marking (minimum): ½" high for 30-gallon and smaller containers, ¾" for over 30 and not over 55 gallons, and 1" for over 55 gallons.

§ 178.109-11 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional test on any other parts which might be considered weaker than the chime.

(2) Hydrostatic pressure test of 40 pounds per square inch sustained for 5 minutes.

[29 FR 18893, Dec. 30, 1964, as amended by Order 66, 30 FR 5755, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.109-12 Leakage test.

(a) Each drum shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 10 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66201, Nov. 19, 1979]

§ 178.109-13 Defective containers.

(a) Leaks and other defects shall be repaired by welding, using welding material of the same composition as originally used by the manufacturer of the drum or other approved aluminum base alloy of equal corrosion and strength qualities.

§ 178.115 Specification 17C; steel drums.

Single trip container. Removable head containers which will pass all required tests are authorized.

§ 178.115-1 Compliance.

(a) Required in all details.

§ 178.115-2 Rated capacity.

(a) Rated capacity as marked, see § 178.115-10(a)(3). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 178.115-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.115-5 Seams.

(a) Body seams welded.

§ 178.115-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type [1]	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
5[3]	Straight side	[1]24	[3]24	None		
10	......do	20	20	......do		
30	......do	18	18	([1])		
55	......do	16	16	([1] [2])		

[1] Rolled or swedged-in hoops.

[2] Each removable head drum body must have three rolled or swedged-in hoops with the centerline of one not more than 3 inches from the top curl.

[3] A drum of 5¼ gallons marked capacity is authorized for shipment of the commodity specified in § 173.353(d) of this chapter.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
16	0.0598	0.0533
18	.0478	.0428
30	.0359	.0324
24	.0239	.0209

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

§ 178.115-7 Convex heads.

(a) Convex (crowned) heads, not extending beyond level of chime, required for drums of 25 gallons capacity or over; minimum convexity of ⅜ inch required.

§ 178.115-8 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.7 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug or cap, must have 3 or more complete threads; two drainage holes of not over 5/16-inch diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 3 threads when tightened with gasket in place. Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

(d) Full removable head drums over 5 gallons capacity must be closed by means of 12 gauge bolted ring with drop forged lugs, one of which is threaded, and having ⅜ inch bolt and nut for drums not over 30 gallons capacity and ⅝ inch bolt and nut for drums over 30 gallons capacity. Five gallon drums must be of lug type closure with cover having at least 16 lugs. Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964, as amended by Order 67, 30 FR 7425, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66201, Nov. 19, 1979]

§ 178.115-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.115-10 Marking.

(a) Marking on each container by embossing on head except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) DOT-17C. The letters STC; located near the DOT mark to indicate "single-trip container." In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress-relieving or heat-treatment during manufacture (for example, DOT-17C-304 or DOT-17C-304 HT as applicable) shall be shown.

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 14-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5755, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For amendments to § 178.115-10 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.115-11 Size of markings.

(a) Size of markings (minimum): ½" high for 33 gallons or less, ¾" for over 33 and not over 55 gallons.

§ 178.115-12 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 40 pounds per square inch sustained for 5 minutes; except that full removable head drums must sustain 20 pounds per square inch.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5755, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.115-13 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure. Removable head containers need not be tested with heads in place except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every 4 months. Samples last tested must be retained until further tests are made or for 1 year.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66201, Nov. 19, 1979]

§ 178.116 Specification 17E; steel drums.

Single trip container. Removable head containers not authorized.

§ 178.116-1 Compliance.

(a) Required in all details.

§ 178.116-2 Rated capacity.

(a) Rated capacity as marked, see § 178.116-10(a)(3). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 178.116-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.116-5 Seams.

(a) Body seams welded.

§ 178.116-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type [1]	Minimum	
					Size (gauge or inch)	Weight (pounds per foot)
5	Straight side	24	24	None		
10	do	22	22	do		
30	do	[2] 19	[2] 19	([1])		
55	do	[2] 18	18	([1])		

[1] Rolled or swedged-in hoops.
[2] 20 gauge authorized.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
18	0.0478	0.0428
19	.0418	.0378
20	.0359	.0324
22	.0299	.0269
24	.0239	.0209

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-31, 39 FR 10910, Mar. 22, 1974; 39 FR 11891, Apr. 1, 1974]

§ 178.116-7 Convex heads.

(a) Convex (crowned) heads, not extending beyond level of chime, required for drums of 25 gallons capacity or over. Convexity to be minimum of ⅜".

§ 178.116-8 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part (plug cap plate etc., see Note 1) must be of metal as thick as prescribed for head of container: *Provided*, That thinner metal closures or closures of other material are authorized for containers of 12 gallons capacity or less when opening to be closed is not over 2.7 inches in diameter and closures, except threaded metal closures, are fitted with outside sealing devices which cannot be removed without destroying the closure or sealing device (see paragraph (d) of this section).

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or cap, must have 3 or more threads; two drainage holes of not over 5/16 inch diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 3 threads when screwed home with gasket in place: *Provided*, That for containers having a capacity of 12 gallons and less the seat (flange, etc.) for plug, or cap, must have two or more complete threads and plug, or cap, must have sufficient length of thread to engage two threads when screwed home with gasket in place.

(d) Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66201, Nov. 19, 1979]

§ 178.116-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.116-10 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) DOT-17E. The letters STC; located near the DOT mark to indicate "single-trip container." In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress-relieving or heat-treatment during manufacture (for example, DOT-17E-304 or DOT-17E-304 HT as applicable) shall be shown.

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 12-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5755, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For amendments to § 178.116-10 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.116-11 Size of markings.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons.

§ 178.116-12 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 15 pounds per square inch sustained for 5 minutes.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5755, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.116-13 Leakage test.

(a) Each drum shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 7 pounds per square inch for containers over 12 gallons capacity and at least 5 pounds for others. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66201, Nov. 19, 1979]

§ 178.117 Specification 17F; steel drums.

Single trip container. Removable head containers not authorized.

§ 178.117-1 Compliance.

(a) Required in all details.

§ 178.117-2 Rated capacity.

(a) Rated capacity as marked, see § 178.117-11(a)(3). Actual capacity of containers shall be not less than rated (marked) capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 1 quart, except that for containers over 30 gallons marked capacity actual capacity shall be not less than rated capacity plus 2 percent, nor greater than rated capacity plus 2 percent plus 2 quarts.

§ 178.117-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel. Steel to be as high as practicable in tensile strength, having no loose oxide scale.

§ 178.117-5 Seams.

(a) Body seams welded.

(b) Head and chime seams welded or double-seamed.

(c) Flanges for closures welded in place.

§ 178.117-6 Chime reinforcement.

(a) Chime reinforcement required to be not less than 12 gauge (see § 178.117-7(b)).

§ 178.117-7 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)		Rolling hoops		
		Body sheet	Head sheet	Type	Minimum	
					Size	Weight
55	Straight side	16	16	([1])		

[1] Rolled or swedged-in hoops. Use of I-bar hoops authorized.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness[1] (inch)	Minimum thickness[1] (inch)
12	0.1046	0.0946
16	.0598	.0533

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

§ 178.117-8 Rolling hoops and convex heads.

(a) *Rolling hoops.* Rolling hoops to be expanded. Alternate use of I-bar hoops authorized.

(b) *Convex heads.* Convex (crowned) heads; minimum convexity to be ⅜ inch, with minimum chime height of ⅞ inch.

§ 178.117-9 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Closing part (plug, cap, plate, etc., see Note 1) must be of metal as thick as prescribed for head of container; this not required for containers of 12 gallons or less when the opening to be closed is not over 2.3 inches in diameter. If unthreaded cap is used it must be provided with outside sealing devices which cannot be removed without destroying the cap or sealing device.

NOTE 1: This does not apply to cap seal over a closure which complies with all requirements.

(c) Closure must be of screw-thread type or fastened by screw-thread device.

(d) One opening not over 2.3 inches and one opening not over ¾ inch allowed; both openings to be welded in one head only. Threads to be standard pipe thread of 11 threads per inch for the larger opening and 14 threads per inch for the ¾-inch opening.

§ 178.117-10 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.117-11 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter as follows:

(1) DOT-17F. The letters STC; located near the DOT mark to indicate "single-trip container." In addition,

when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress-relieving or heat-treatment during manufacture (for example, DOT-17F-304 or DOT-17F-304 HT as applicable) shall be shown.

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 12-55-50).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5755, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.117-11 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.117-12 Size of markings.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons.

§ 178.117-13 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 6 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 80 pounds per square inch sustained for 5 minutes.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5755, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.117-14 Leakage test.

(a) Each container shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 15 pounds per square inch. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.118 Specification 17H; steel drums.

Single-trip container. Removable head required.

§ 178.118-1 Compliance.

(a) Required in all details.

§ 178.118-2 Rated capacity.

(a) Rated capacity as marked, see § 178.118-10(a)(3). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 178.118-3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.118-5 Seams.

(a) Body seams welded.

§ 178.118-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallons)	Type of container	Minimum thickness, uncoated sheets (gauge)			Rolling hoops		
		Body sheet	Bottom head sheet	Removable head sheet	Type	Minimum	
						Size (gauge or inch)	Weight (pounds per foot)
5	Straight side	24	24	20	None		
30	......do	18	18	18	([1])		
55	......do	18	18	[3] 14	([2])		

[1] Rolled or swedged-in hoops.

[2] Each drum must have three rolled or swedged-in hoops, one to be placed in the body near the top curl.

[3] 16 gauge authorized provided there is at least one corrugation in the removable head near the periphery. 18-gauge authorized provided (1) there are at least two corrugations in the removable head near the periphery, (2) the manufacturer or assembler provides to the Director, OHMO, evidence of satisfactory performance of testing of the complete package design conducted in accordance with this section, and (3) the director issues a registration number which the manufacturer or assembler concerned durably marks on the removable head and its corresponding ring-closure device.

(b) Steel sheets of specified gauge shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
14	0.0747	0.0677
16	.0598	.0533
18	.0478	.0428
20	.0359	.0324
24	.0239	.0209

[1] Thickness shall be measured at any point on the sheet not less than 3/8 inch from an edge.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-44, 42 FR 61465, Dec. 5, 1977]

§ 178.118-7 Convex heads.

(a) Convex (crowned) heads, not extending beyond level of chime, required for drums of 25 gallons capacity or over; minimum convexity of 3/8 inch required.

§ 178.118-8 Closures.

(a) Adequate to prevent leakage; gaskets required.

(b) Drums over 5 gallons capacity must be closed by means of 12 gauge bolted ring with drop forged lugs, one of which is threaded, and having 3/8 inch bolt and nut for drums not over 30 gallons capacity and 5/8 inch bolt and nut for drums over 30 gallons capacity. Five gallon drums must be of lug type closure with cover having at least 16 lugs. Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

(c) For closure with threaded plug or cap, the seat (flange, etc.) for plug, or cap, must have 3 or more threads; two drainage holes of not over 5/16 inch diameter are allowed. Plug, or cap, must have sufficient length of thread to engage 3 threads when screwed home with gasket in place: *Provided*, That for containers having a capacity of 12 gallons and less the seat (flange, etc.) for plug, or cap, must have two or more complete threads and plug, or cap, must have sufficient length of thread to engage two threads when screwed home with gasket in place.

(1) Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.118-9 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.118-10 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) DOT-17H. The letters STC; located near the DOT mark to indicate "single-trip container." In addition, when the container is of stainless steel, the type of steel used in body and head sheets as identified by American Iron and Steel Institute type number, and also the letters HT following steel designation on containers subjected to stress-relieving or heat-treatment during manufacture (for example, DOT-17H-304 or DOT-17H-304 HT as applicable) shall be shown.

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 12-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.118-10 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.118-11 Size of markings.

(a) Size of markings (minimum): ½" high for 33-gallon or less, ¾" for over 33 and not over 55 gallons.

§ 178.118-12 Type tests.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type tests are as follows:

(1) Test by dropping, filled with water to 98 percent capacity, from height of 4 feet onto solid concrete so as to strike diagonally on chime, or when without chime seam, to strike on other circumferential seam; also additional drop test on any other parts which might be considered weaker than the chime. Closing devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

(2) Hydrostatic pressure test of 15 pounds per square inch sustained for 5 minutes.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.118-13 Leakage test.

(a) Each drum shall be tested, with seams under water or covered with soapsuds or heavy oil, by interior air pressure of at least 7 pounds per square inch for containers over 12 gallons capacity and at least 5 pounds for others. Equally efficient means of testing may be authorized upon approval by the Associate Director for OE. Leakers shall be rejected or repaired and retested without failure. Drums need not be tested with heads in place, except that samples taken at random and closed as for use, of each type and size, must be tested at start of production and repeated every 4 months. Samples last tested must be retained until further tests are made or for 1 year.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.120 Specification 20PF phenolic-foam insulated, metal overpack.

[Amdt. 178-35, 39 FR 45247, Dec. 31, 1974]

§ 178.120-1 General requirements.

(a) Each overpack must meet all of the applicable requirements of § 173.24 of this subchapter.

(b) The maximum gross weight of the package, including the inner cylinder and its contents, must not exceed the following:

(1) Specification 20PF-1—138 kilograms (300 pounds).

(2) Specification 20PF-2—320 kilograms (700 pounds).

(3) Specification 20PF-3—455 kilograms (1000 pounds).

(c) The general configuration of the overpack must be a right cylinder, consisting of an insulated base section, a steel liner lid, and an insulated top section. The inner liner and outer shell must be at least 16-gauge and 18-gauge steel, respectively, with the intervening cavity filled with a molded-in-place, fire-resistant, phenolic-foam insulation interspersed with wooden members for bracing and support Wood pieces must be securely attached to both the liner and shell. No hole is permitted in the liner. Each joint between sections must be stepped a minimum of 5 centimeters (2 inches) and gaps between mating surfaces must not exceed 5 millimeters (0.2-inch). Gaps between foam surface of top section and liner lid must not exceed 1 centimeter (0.4-inch) or 5-centimeters (2 inches) where taper is required for mold stripping. For the specification 20PF-1, the top section may consist of a plug of foam insulation and a steel cover. The liner and shell closures must each be gasketed against moisture penetration. The liner must have a bolted flange closure. Shell closure must conform to § 178.118-8(b).

(d) Drawings in CAPE-1662, which include bills of material are a part of this specification.

[Amdt. 178-35, 39 FR 45247, Dec. 31, 1974]

§ 178.120-2 Materials of construction and other requirements.

(a) Phenolic foam insulation must be fire-resistant and fabricated in accordance with USDOE Material and Equipment Specification SP-9, Rev. 1 and Supplement, which is a part of this specification. (Note: Packagings manufactured under USAEC Specification SP-9 and Rev. 1 thereto are authorized for continued manufacture and use.) A 5.4-inch (13.7 centimeter) minimum thickness of foam must be provided over the entire liner except:

(1) Where wood spacers replace the foam; or

(2) At protrusions of liner or shell, such as flanges, baffles, etc., where minimum insulation thickness is 9 centimeters (3.5 inches); or

(3) Where alternate top section (specification 20PF-1) is used. Foam must not interfere with proper seating of screws in inner liner flange assembly. Average density of insulation must be 0.13 g/cc (8 pounds per cubic foot (pcf)) minimum for bottom section and 0.16 g/cc (10 pcf) minimum for top section, except 0.1 g/cc (6.5 pcf) for the specification 20PF-1 top section.

(b) Gaskets must be as follows:

(1) Inner liner flange—Neoprene rubber of 30 to 60 type A durometer hardness or other equivalent gasket material which is compatible with the specific contents.

(2) Outer shell—Synthetic rubber conforming to MIL-R-6855 (available from the Naval Publications Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120) class 2, grade 60.

(3) Support and pressure pads for inner liner top and bottom must be sponge rubber or equivalent.

(c) Alternate top section (specification 20PF-1 only). Average insulation density must be 0.16 g/cc (10 pcf minimum). Thickness of plug must be 11 centimeters (4.3 inches) minimum, except thickness may be reduced to 10 centimeters (4 inches) to clear bolt heads. A flush mounted top lifting device must be securely fastened to a wood block encapsulated by the foam.

(d) Vent holes 5 millimeters (0.2-inch) diameter must be drilled in the outer shell to provide pressure relief during the insulation foaming and in the event of a fire. These holes, which must be drilled in all areas of the shell which mate with the foam insulation, must be spaced in accordance with CAPE-1662.

(e) Welding must be by a fusion welding process in accordance with American Welding Society Codes B-3.0 and D-1.0. Body seams and joints for the liner or shell must be continuous welds.

(f) Waterproofing. Each screw hole in the outer shell must be sealed with appropriate resin-type sealing material, or equivalent, during installation of the screw. All exposed foam surfaces, including any vent hole, must be sealed with waterproofing material as prescribed in USDOE Material and Equipment Specification SP-9, Rev. 1 and Supplement, or equivalent.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-35, 39 FR 45247, Dec. 31, 1974, as amended by Amdt. 178-56, 44 FR 49458, Aug. 23, 1979]

§ 178.120-3 Tests.

(a) Leakage test—Each inner liner assembly must be tested for leakage prior to installation. Seam welds of the liner must be covered for a distance of at least 15 centimeters (6 inches) on either side of the seam with soapsuds, heavy oil, or equivalent material, and interior air pressure applied to at least 776mm Hg (15 p.s.i.g.) above atmospheric pressure must be held for at least 30 seconds. Liners failing to pass this test may not be used until repairs are made, and retests successfully passed.

[Amdt. 178-35, 39 FR 45247, Dec. 31, 1974]

§ 178.120-4 Required markings.

(a) Marking must be as prescribed in § 173.24 of this subchapter.

(b) Marking on the outside of each overpack must be as follows:

(1) "USA-DOT-20PF-1" or "-2," as appropriate, and if the entire liner is made of stainless steel, additional marking such as "3041-SS" to indicate the type of stainless steel used.

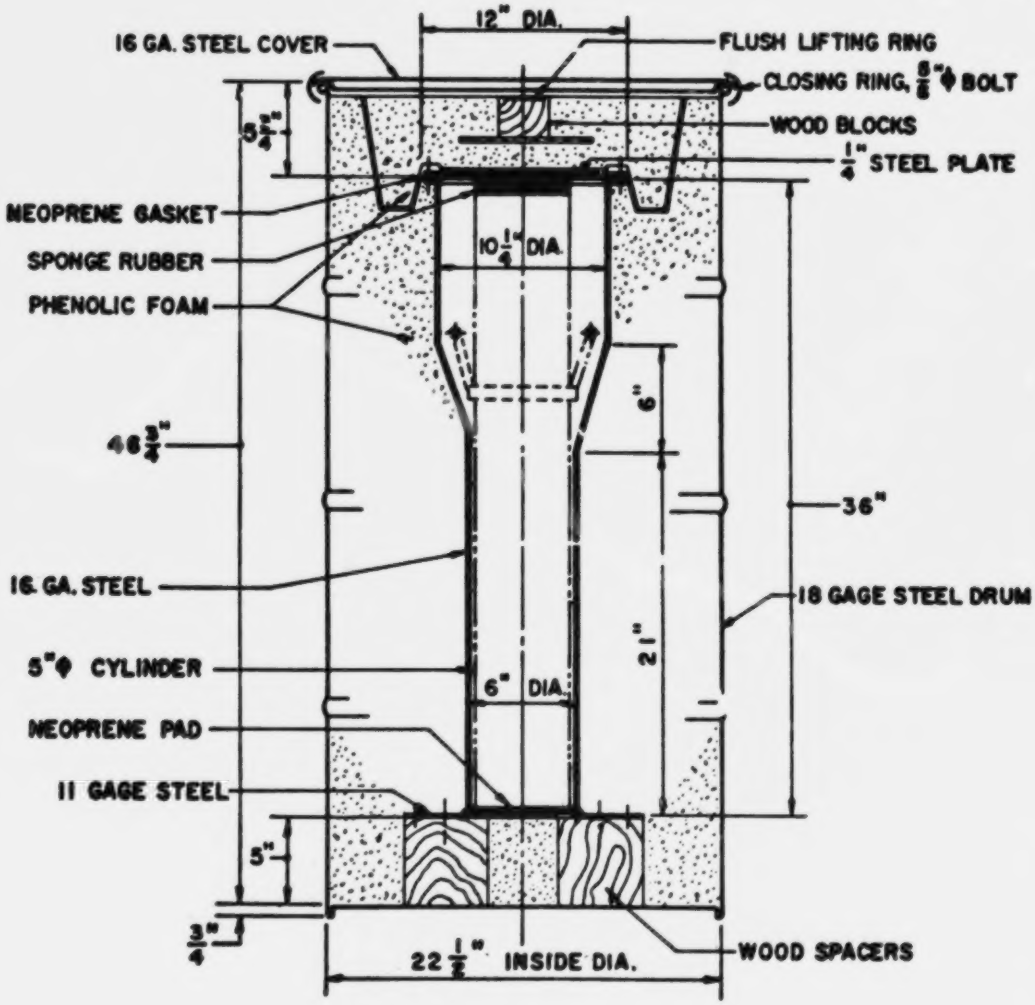
(2) "TARE WT: xxx lbs." where xxx is the tare weight of the assembled overpack without the inner container.

(3) Year of manufacture.

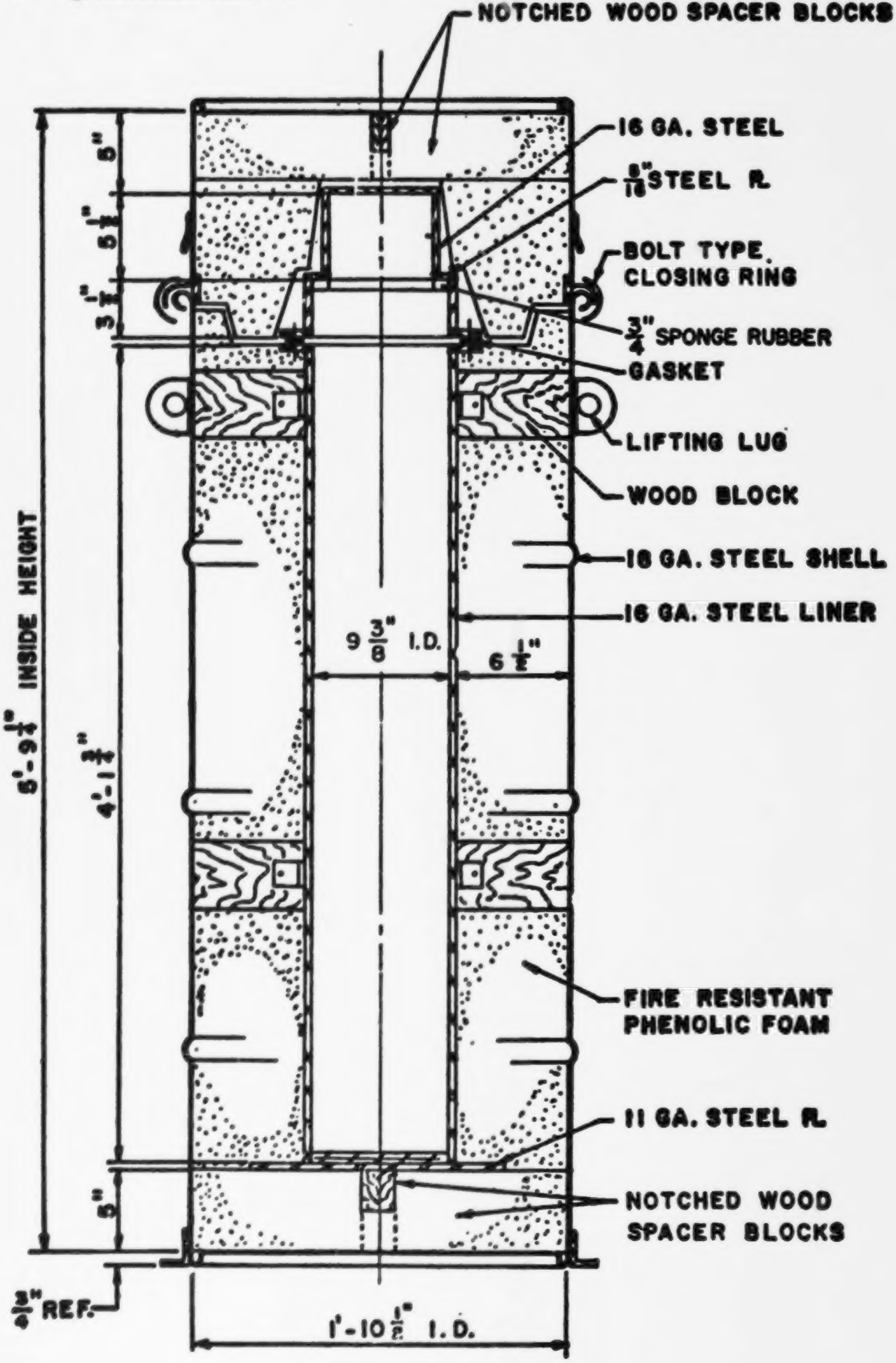
[Amdt. 178-35, 39 FR 45247, Dec. 31, 1974]

§ 178.120-5 Typical assembly detail.

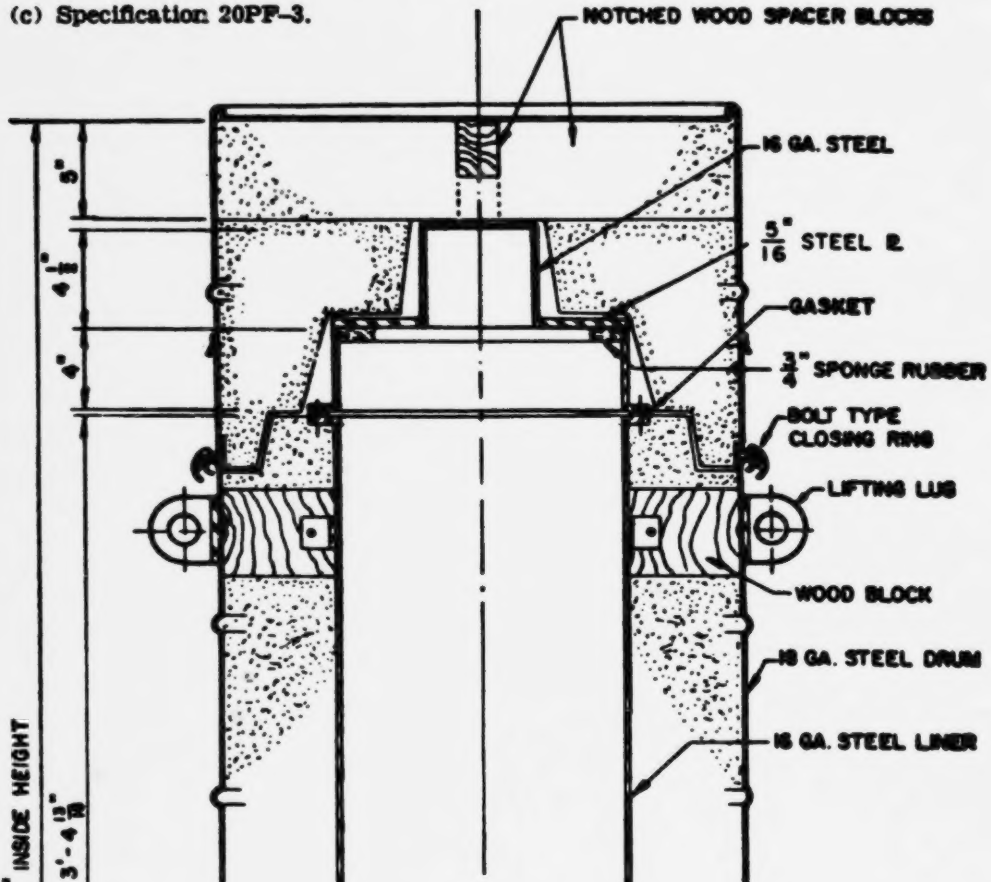
(a) Specifications 20PF-1.


12" DIA.
16 GA. STEEL COVER
FLUSH LIFTING RING
CLOSING RING, 5/8" Φ BOLT
WOOD BLOCKS
1/4" STEEL PLATE
5 3/4"
NEOPRENE GASKET
SPONGE RUBBER
10 1/4" DIA.
PHENOLIC FOAM
6"
46 3/4"
36"
16. GA. STEEL
18 GAGE STEEL DRUM
21"
5" Φ CYLINDER
6" DIA.
NEOPRENE PAD
11 GAGE STEEL
5"
3/4"
22 1/2" INSIDE DIA.
WOOD SPACERS

(b) Specification 20PF–2.


NOTCHED WOOD SPACER BLOCKS
16 GA. STEEL
5/16" STEEL PL.
BOLT TYPE CLOSING RING
3/4" SPONGE RUBBER
GASKET
LIFTING LUG
WOOD BLOCK
16 GA. STEEL SHELL
16 GA. STEEL LINER
9 3/8" I.D.
6 1/2"
FIRE RESISTANT PHENOLIC FOAM
11 GA. STEEL PL.
NOTCHED WOOD SPACER BLOCKS
5"
5 1/2"
3 1/2"
5'-9 1/4" INSIDE HEIGHT
4'-1 3/4"
5"
3/4" REF.
1'-10 1/2" I.D.

(c) *Specification 20PF–3.*


NOTCHED WOOD SPACER BLOCKS
16 GA. STEEL
5/16" STEEL PL
GASKET
3/4" SPONGE RUBBER
BOLT TYPE CLOSING RING
LIFTING LUG
WOOD BLOCK
18 GA. STEEL DRUM
16 GA. STEEL LINER
FIRE RESISTANT PHENOLIC FOAM
11 GA. STEEL PL
NOTCHED WOOD SPACER BLOCKS
5"
4 1/8"
4"
3'-4 13/16"
5"
4'-11 3/4" INSIDE HEIGHT
1'-1 1/4" INSIDE DIA.
5 5/16"
REF.
2'-0" INSIDE DIA.

[Amdt. 178–35, 39 FR 45247, Dec. 31, 1974]

§ 178.121 Specification 21PF fire and shock resistant, phenolic-foam insulated, metal overpack.

[Amdt. 178-35, 39 FR 45250, Dec. 31, 1974]

§ 178.121-1 General requirements.

(a) Each overpack must meet all of the applicable requirements of § 173.24 of this subchapter.

(b) Each overpack is authorized for use in applications where the maximum gross weight of the package, including the inner container and contents does not exceed 3725 kilograms (8200 pounds), (horizontally-loaded specification 21 PF-1 unit), or 3900 kilograms (8600 pounds), (end-loaded specification 21 PF-2 unit).

(c) The general configuration of the overpack must be a right cylinder, consisting of a steel inner liner (at least 16-gauge) and steel outer shell (at least 14-gauge) with the intervening cavity filled with a molded-in-place, fire-resistant, phenolic foam insulation and interspersed wooden members for bracing and support. Two specific configurations are authorized; a horizontal loading unit (specification 21PF-1) consisting of insulated base and top sections jointed in a longitudinal peripheral closure joint; or an end-loading unit (specification 21PF-2), consisting of an insulated main section, a steel plate liner lid, and an insulated end cap. For either type each joint between sections must be stepped at least 1.8 centimeters (0.75-inch) and gaps between mating surfaces may not exceed 5 millimeters (0.2-inch). Bolted closures, which must each be gasketed against moisture penetration, must be in accordance with CAPE-1662. Each bolt must be equipped with a locking device to prevent loosening from vibration. Outer steel bracing and support framework must be attached to the shell to facilitate normal handling.

(d) Drawings in CAPE-1662, which include bills of materials, are a part of this specification.

[Amdt. 178-35, 39 FR 45250, Dec. 31, 1974; 40 FR 2435, Jan. 13, 1975]

§ 178.121-2 Materials of construction and other requirements.

(a) Phenolic foam insulation must be fire resistant and fabricated in accordance with USDOE Material and Equipment Specification SP-9, Rev. 1 and Supplement, which is a part of this specification. (Note: Packagings manufactured under USAEC Specification SP-9, and Rev. 1 thereto are authorized for continued manufacture and use.) A 5.5-inch (14 centimeter) minimum thickness of foam must be provided over the entire liner except where:

(1) Wood spacers replace the foam material; or

(2) At protrusions of liner or shell, such as flanges, baffles, etc., where the minimum thickness of foam, wood, or a combination of these is 10 centimeters (4 inches).

(3) Solid wood or laminated wood solidly glued may be used to replace the foam between liner and shell (i.e., in ends of overpack). In this case, minimum wood thickness is 10 centimeters (4 inches). Average density of insulation must be 0.1g/cc (6.75 pounds per cubic foot (pcf)) minimum, except that 0.13 g/cc (8 pcf) is required in the removable end cap of the specification 21PF-2, which must have a minimum foam thickness of 12.7 centimeters (5 inches).

(b) Gaskets for inner liner, outer shell, or where otherwise specified in CAPE-1662, must be of vinyl foam tape, single coated, or 6 millimeters (¼-inch) thick expanded rubber, per ASTM D1056, type R or S, grades 41 to 43, with adhesive backing, or equivalent.

(c) Support and pressure pads for the inner liner must be of neoprene, sponge rubber, or equivalent.

(d) Fire-retardant (intumescent) paint must be applied to any wood blocking which is located at any joint in the shell.

(e) Vent holes 5 millimeters (0.2-inch) diameter must be drilled in the outer shell to provide pressure relief during the insulation foaming and in the event of a fire. These holes, which must be drilled in all areas of the shell which made with the foam insulation, must be spaced in accordance with CAPE-1662.

(f) Welding must be by a fusion process in accordance with the American Welding Society Code. Body seams and joints for the liner and shell must be continuous welds.

(g) Waterproofing. Each screw hole in the outer shell must be sealed with appropriate resin-type sealing material, or equivalent, during installation of the screw. All exposed foam surfaces, including any vent hole, must be sealed with waterproofing material as prescribed in USDOE Material and Equipment Specification SP-9, Rev. 1 and Supplement, or equivalent.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-35, 39 FR 45250, Dec. 31, 1974, as amended by Amdt. 178-56, 44 FR 49459, Aug. 23, 1979]

§ 178.121-3 Required markings.

(a) Markings must be as prescribed in § 173.24 of this subchapter.

(b) Marking on the outside of each overpack must be as follows:

(1) "USA-DOT-21PF-1" or "2", as appropriate, and, if the inner shell is of stainless steel, additional marking such as "304L-SS" to indicate the type of stainless steel used.

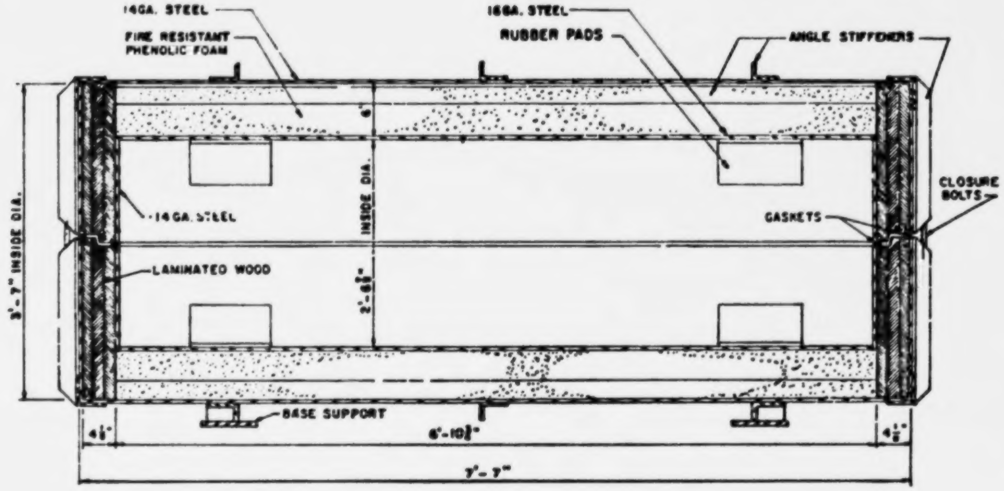
(2) "TARE WT: xxx lbs. (or kg.)" where xxx is the tare weight of the assembled overpack without the inner container.

(3) Year of manufacture.

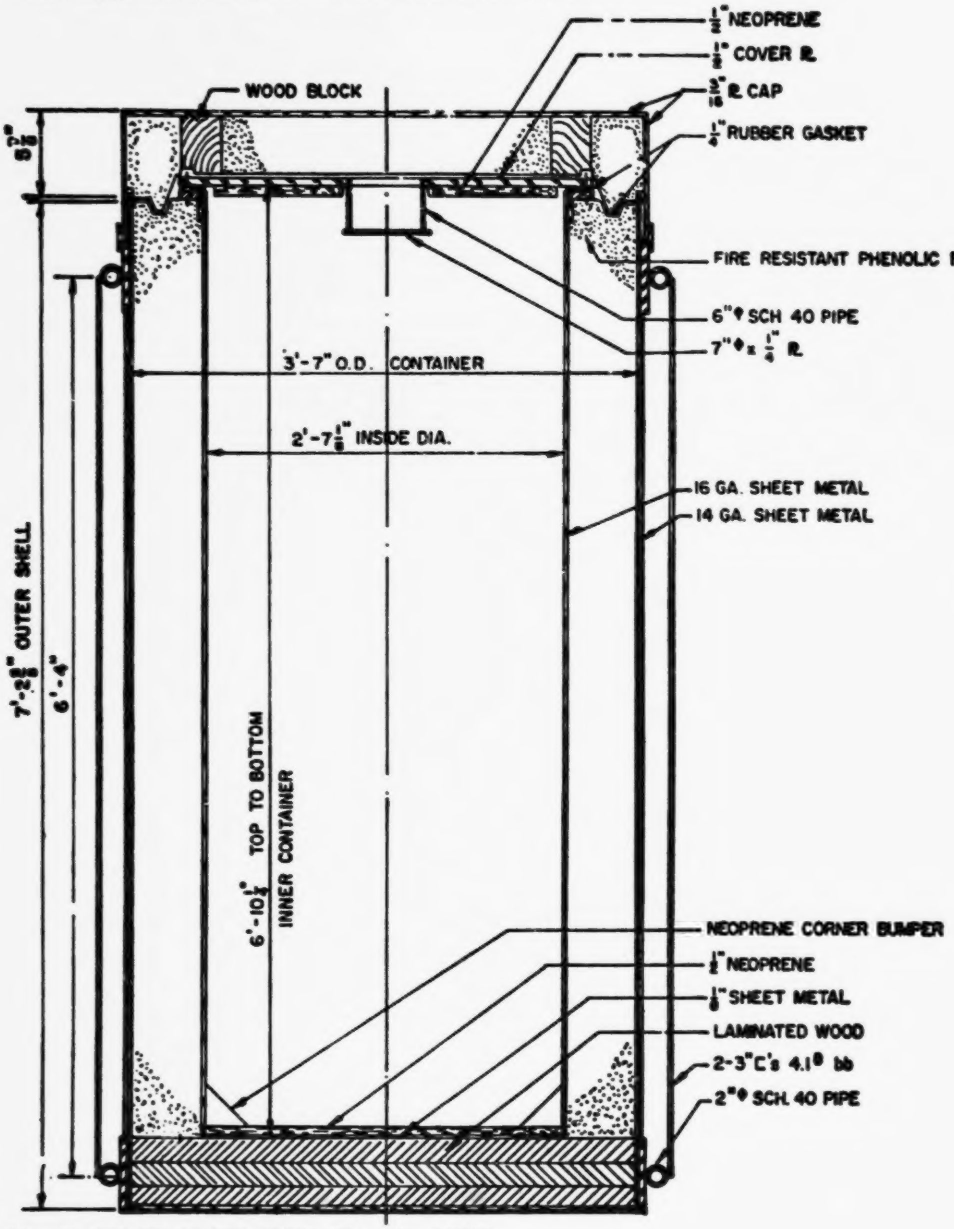
[Amdt. 178-35, 39 FR 45251, Dec. 31, 1974]

§ 178.121-4 Typical assembly detail.

(a) Specification 21PF-1 (horizontal loading overpack).


14GA. STEEL
FIRE RESISTANT PHENOLIC FOAM
16GA. STEEL
RUBBER PADS
ANGLE STIFFENERS
CLOSURE BOLTS
GASKETS
14GA. STEEL
LAMINATED WOOD
BASE SUPPORT
3'-7" INSIDE DIA.
6"
2'-6⅝" INSIDE DIA.
4⅛"
6'-10⅜"
4⅛"
7'-7"

(b) Specification 21 PF–2 (end loading overpack).



1/2" NEOPRENE
1/8" COVER PL
3/16" PL CAP
1/4" RUBBER GASKET
WOOD BLOCK
5 3/16"
FIRE RESISTANT PHENOLIC FOAM
6" ϕ SCH 40 PIPE
7" ϕ x 1/4" PL
3'-7" O.D. CONTAINER
2'-7 1/8" INSIDE DIA.
16 GA. SHEET METAL
14 GA. SHEET METAL
7'-2 5/8" OUTER SHELL
6'-4"
6'-10 1/2" TOP TO BOTTOM INNER CONTAINER
NEOPRENE CORNER BUMPER
1/2" NEOPRENE
1/8" SHEET METAL
LAMINATED WOOD
2-3" C's 4.1# bb
2" ϕ SCH. 40 PIPE

[Amdt. 178-35, 39 FR 45251, Dec. 31, 1974]

§ 178.130 Specification 37K; steel drums.

Single trip container. Removable head containers which will pass all required tests are authorized.

§ 178.130–1 Compliance.

(a) Required in all details.

§ 178.130–2 Rated capacity.

(a) Rated capacity as marked, see § 178.130–8(a)(3). Actual capacity not less than rated (marked) capacity plus 2 percent, not greater than rated capacity plus 2 percent plus 1 quart.

§ 178.130–3 Composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.130–5 Parts and dimensions.

(a) Parts and dimensions as follows:

Marked capacity not over (gallon)	Authorized gross weight not over (pounds)	Type of container	Welded side seam required	Minimum thickness uncoated sheets (gauge)	
				Body sheet	Head sheet
55	275	Straight side....	Yes.........	22	22

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness[1] (inch)	Minimum thickness[1] (inch)
22	0.0299	0.0269

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

§ 178.130–6 Closure required.

(a) Adequate to prevent leakage; to be of bolted ring or lever lock ring types only; sponge rubber gaskets required; flowed-in gaskets not permitted.

§ 178.130–7 Defective containers.

(a) Leaks and other defects to be repaired by method used in constructing container, not by soldering.

§ 178.130–8 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) DOT-37K275.

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 18-55-50). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example 14/12-55-50 for body 14 gauge and head 12 gauge).

(4) The letters STC; located near the DOT mark to indicate "single-trip container".

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For amendments to § 178.130–8 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.130–9 Size of markings.

(a) Size of markings (minimum): ½" high for 30-gallon or less, ¾" for over 30 gallons.

§ 178.130–10 Type test.

(a) Samples taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type test is as follows:

(1) Test by dropping, filled with dry, finely powdered material to the authorized gross weight, from height of 4 feet onto solid concrete so as to strike diagonally on top chime. Closing

devices and other parts projecting beyond chime or rolling hoops must also be capable of withstanding this test.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.131 Specification 37A; steel drums.

Single trip container. Removable head required.

§ 178.131-1 Compliance.

(a) Required in all details.

§ 178.131-2 Rated capacity.

(a) Rated capacity as marked, see § 178.131-9(a)(2). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent for containers not over 12 gallons capacity. Maximum actual capacity of containers not over 12 gallons capacity shall be not greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater; for others, minimum actual capacity shall be not less than rated (marked) capacity plus 2 percent and maximum actual capacity shall not be greater than rated (marked) capacity plus 3 percent or rated (marked) capacity plus 2 percent plus 1 quart whichever is the greater.

§ 178.131-3 Composition.

(a) Sheets for body and heads to be hot-rolled or cold-rolled, low carbon, open-hearth or electric steel or standard commercial quality.

§ 178.131-5 Seams.

(a) Side seams must be welded; or locked and soldered when 28-gauge tin plate is used for containers of 2-gallon capacity or less.

§ 178.131-6 Capacities, weights, type, and gauges.

(a) Capacities, weights, type, and gauges must be as follows:

Marked capacity not over (gallons)	Authorized gross weight not over (pounds)	Type of container	Minimum thickness, uncoated sheets [1] (gauge)		Minimum ring gauge bolted type [2]
			Body sheet [3]	Head sheet	
2	40	Straight side	28	28	Lug.
5	60	......do	26	26	
5	80	......do	24	24	Lug or plain ring seal.
10	160	......do	24	24	
55	150	......do	26	26	18, plain.
55	275	......do	24	24	Do.
55	350	......do	24	24	16, 2 inch overlap.
55	[4] 480	......do	22	22	Do.

[1] All gauges specified are minimum except as provided by Part 173 of this chapter. Heavier (but not lighter) gauges may be specified if shipper so desires.

[2] Other types of closures are authorized if they perform without failure under the tests required by this section and a record of the tests is retained during the period the closure is in use.

[3] Containers of 16 gallons capacity and over must have 2 swedged or corrugated rolling hoops of sufficient height to clear the closing device when the drum is rolled.

[4] A gross weight of 490 pounds is authorized when defined by Part 173 of this chapter (see § 173.164(a)(2) of this chapter).

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
22	0.0299	0.0269
24	.0239	.0209
26	.0179	.0159
28	.0149	.0129

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.131-7 Closures.

(a) Closures of the type specified in the above table adequate to prevent leakage; gaskets required, all closures to be of the full-removable head type. Curl at top of shell for all drums 30 gallons capacity and larger must have a minimum diameter of 7/16 inch, and so made as to form a circular section with the under portion substantially in contact with the vertical shell. The removable head must have a minimum depth of ¾ inch and the cover bib must be large enough to extend to the horizontal center line of the top curl when the drum is sealed with the gasket in place. Drums of less than 30 gallons capacity may be made with an outside curl diameter of ⅜ inch minimum and a head depth of ¾ inch minimum; except that for drums less than 16 gallons capacity the outside curl diameter may be 9/32 inch and the cover depth may be ⅜ inch minimum.

(b) The closing ring must be so constructed that the bottom leg will extend well inside the vertical center line of the shell curl but must not touch the shell (recommended clearance is 1/16 inch minimum, 3/32 inch maximum) when sealed for usage. The top leg of the locking ring must have sufficient length to extend well inside the vertical center line of the curl on the shell. Closing rings must have a 2 inch overlap at joint when gross weight of drum exceeds 275 pounds. Overlap is not required for drums of 275 pounds or less gross weight. The clearance between ends of rings without overlap should be a minimum of ⅛ inch and a maximum of ½ inch.

(c) Closures or fittings in the removable head of any type capable of withstanding test prescribed by § 178.131-11 are authorized.

§ 178.131-8 Defective containers.

(a) Defective containers to be repaired by method used in constructing container. Soldering not authorized, except for tin plated steel as authorized by § 178.131-5.

§ 178.131-9 Marking.

(a) Marking on each container by embossing on head, except that such embossment must be on the permanent head for drums having removable heads, with raised marks, or by embossing or die stamping on footring on drums equipped with footrings, or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) DOT-37A * * *. Stars to be replaced by the authorized gross weight, or less, at which the container was type tested (for example, DOT-37A150).

(2) Gauge of metal in thinnest part, rated capacity in gallons, and year of manufacture (for example, 24-55-54). When gauge of metal in body differs from that in either head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 22/24-55-54 for a container having 22 gauge body, 22 gauge bottom head and 24 gauge top head).

(3) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(4) The letters STC; located near the DOT mark to indicate "single-trip container".

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.131-9 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.131-10 Size of markings.

(a) Size of markings, not less than ½ inch high for all containers.

§ 178.131-11 Type test.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type test is as follows:

(b) Test by dropping on top chime, or other part considered to be weaker, with drum filled to normal loading depth and to the gross weight at which container is marked with dry powdered material, and topped with at least two inches of a finely divided, dry, free-flowing powder of the following sieve analysis:

% retained on 42 mesh = Trace (max.).

% retained on 50 mesh = 3% (max.).
% retained on 100 mesh = 88% (min.).

A material such as sodium bicarbonate is recommended. Container shall be dropped from a height of 4 feet onto solid concrete so as to strike diagonally on the chime and so positioned when equipped with bolted ring type closure that crush pattern will terminate at closure joint. Closing devices and other parts projecting beyond chime or rolling hoops must be capable of withstanding this test. No disc or material other than regular gaskets in closure part is permitted for test purposes.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.132 Specification 37B; steel drums.

Single trip container. Removable head not authorized.

§ 178.132–1 Compliance.

(a) Required in all details.

§ 178.132–2 Rated capacity.

(a) Rated capacity as marked, see § 178.132-9(a)(2). Minimum actual capacity of containers shall be not less than rated (marked) capacity plus 4 percent for containers not over 12 gallons capacity. Maximum actual capacity of containers not over 12 gallons capacity shall be not greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater, for others, minimum actual capacity shall be not less than rated (marked) capacity plus 2 percent and maximum actual capacity shall not be greater than rated (marked) capacity plus 3 percent or rated (marked) capacity plus 2 percent plus 1 quart whichever is the greater.

§ 178.132–3 Composition.

(a) Sheets or body and heads to be hot-rolled or cold-rolled, low carbon, open hearth, or electric steel of standard commercial quality.

§ 178.132–5 Seams.

(a) Side seams may be welded, Gordon lock, or other equally efficient construction.

§ 178.132–6 Capacities, weights, type and gauges.

(a) Capacities, weights, type and gauges must be as follows:

Marked capacity not over (gallons)	Authorized gross weight not over (pounds)	Type of container	Minimum thickness, uncoated sheets (gauge)	
			Body sheet[1]	Head sheet
5	60	Straight side	28	28
55	275	do	26	26
55	450	do	24	24
55	650	do	22	[2] 22

[1] Containers of 16 gallons capacity and over must have small or series corrugations rolled into the shell or 2 swedged or corrugated rolling hoops.

[2] Twenty-four (24) gauge top head and cover authorized.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness[1] (inch)	Minimum thickness[1] (inch)
22	0.0299	0.0269
24	.0239	.0209
26	.0179	.0159
28	.0149	.0129

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

§ 178.132–7 Closures.

(a) Closures shall be of any type that will withstand prescribed drop tests without leakage, see § 178.132-11 of this section. Openings shall not exceed 9 inches in diameter in containers of 16-gallon capacity and larger nor 6½ inches in diameter in containers less than 16-gallon capacity. Larger openings may be used when approved by the Associate Director for OE.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.132–8 Defective containers.

(a) To be repaired by method used in constructing container except that Gordon lock, or other similarly constructed seam must be welded. Soldering not authorized.

§ 178.132–9 Marking.

(a) Marking on each container by embossing on head with raised marks, or by embossing or die stamping on foot-ring on drums equipped with footrings or on metal plates securely attached to drum by brazing or welding not less than 20 percent of the perimeter, as follows:

(1) DOT-37B * * *. Stars to be replaced by the authorized gross weight, or less at which container was type tested (for example, DOT-37B450, etc.).

(2) Gauge of metal in thinnest part (except closure cover), rated capacity in gallons, and year of manufacture (for example, 24-55-54). When gauge of metal in body differs from that in either head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 22/24-55-54 for a container having 22-gauge body, 22-gauge bottom head and 24-gauge top head).

(3) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(4) The letters STC; located near the DOT mark to indicate "single-trip container".

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.132-9 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.132-10 Size of markings.

(a) Size of markings (minimum), not less than ½ inch high for all containers.

§ 178.132-11 Type test.

(a) Samples, taken at random and closed as for use, shall withstand prescribed tests without leakage. Tests to be made of each type and size by each company starting production and to be repeated every 4 months. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. The type test is as follows:

(b) Test by dropping on top chime, filled with dry finely powdered material to the gross weight at which container is marked, from a height of 4 feet onto solid concrete so as to strike diagonally on the chime and so positioned as to strike, in the case of offset openings, at the point on the chime nearest the opening. Closing devices and other parts projecting beyond chimes must also be capable of withstanding this test.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.133 Specification 37P; steel drums with polyethylene liner.

Nonreusable containers.

§ 178.133-1 Compliance.

(a) Required in all details.

§ 178.133-2 Rated capacity of assembled composite containers.

(a) Rated capacity as marked, see § 178.133-9. Minimum actual capacity of containers shall be not less than rated (marked) capacity, plus 4 percent. Maximum actual capacity shall not be greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 178.133-3 Steel composition.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.133-4 Seams.

(a) Side seams welded.

(b) Chime of permanent head, double seamed.

§ 178.133-5 Parts and dimensions for steel drums.

(a) Parts and dimensions for steel drums shall be as follows:

Drums for plastic liner of rated capacity not over (gallons)	Type of container [1] [2]	Body sheet (gauge)	Bottom head sheet (gauge)	Removable head sheet (gauge)	Type of removable head closure
5	Straight side, single bead	26	26	24	Ring seal, bolted ring, lug cover.
6½	......do	24	24	24	Do.
15	Straight side [3]	22	22	[4] 19	Do.

[1] Drum interior shall be free of projections, burrs, or any edges that will cause damage to liners, and shall be free of lubricants, oil or other foreign matter. Drum shall provide a snug fit for the plastic liner.

[2] One hole not over 3/16 inch in diameter permitted in body or a head, or two ⅛ inch holes in bottom head near the chime.

[3] For containers up to 10 gallons capacity, a single rolled or swedged bead in body near top curl required; for containers of 10 gallons and greater capacity, 2 rolled or swedged rolling hoops in drum body required.

[4] Twenty (20) gauge authorized.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
19	0.0418	0.0378
20	.0359	.0324
22	.0299	.0269
24	.0239	.0209
26	.0179	.0159

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from edge.

§ 178.133-6 Liner.

(a) Each metal drum shall contain a contour fitting polyethylene liner having heat-sealed seams or a one-piece seamless molded polyethylene unit, attached to the pour opening in the removable head so as to provide a container that is completely resistant to lading when closed as for use.

(b) Polyethylene liner or molded unit shall be fabricated throughout of virgin polyethylene tubing or mold material, which may include a low percentage of elastomeric polymer having minimum thickness of 0.010 inch and having the following physical properties:

(1) Resin should have maximum melt index value of 1.8 plus 0.4 per 10 minutes, and shall have a minimum average molecular weight of 21,000.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.133-7 Closure.

(a) Closure shall be resistant to lading and adequate to prevent leakage. Openings in removable head shall not be over 2.85 inches in diameter. Venting closures are permitted when required by Part 173 of this chapter.

§ 178.133-8 Defective containers.

(a) Repaired polyethylene liners are not authorized.

§ 178.133-9 Marking.

(a) Marking on the permanent head of each container by embossing with raised marks as follows:

(1) DOT-37P. The letters NRC located just above or below the DOT mark to indicate a nonreusable container.

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauge of metal in thinnest part, rated capacity of assembled composite container in gallons, and year of manufacture (for example, 24-5-57). When gauge of metal in body differs from that in head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 26/24-557 for body 26-gauge and head 24-gauge).

[29 FR 18894, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.133-9 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.133-10 Size of markings.

(a) Size of markings (minimum) ½ inch high.

§ 178.133-11 Type tests.

(a) Three samples of each size container manufactured taken at random, filled with water to 98 percent of actual capacity and closed as for use, shall withstand drop tests from height of 4 feet onto solid concrete as prescribed by paragraphs (a)(1), (2) and (3) of this section, without leakage or potentially hazardous rupture of outside container. Tests shall be made at start of production and repeated at 4-month intervals thereafter. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter. No single container shall be expected to withstand more than one of the following:

(1) Diagonal drop on top chime.

(2) Diagonal drop on bottom chime.

(3) Flat drop on side of drum.

(b) Completely assembled composite containers of each size manufactured, filled to 98 percent of actual capacity with water, shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for one hour using an amplitude of one inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.133-12 Test.

(a) Each assembled container shall be tested by retaining at least 1½ pounds per square inch air pressure at equilibrium without showing pressure drop on a suitable gauge.

§ 178.134 Specification 37M; cylindrical steel overpack, straight sided for inside plastic container; nonreusable containers.

§ 178.134-1 Material requirements.

(a) Sheets for body and heads to be low carbon, open hearth or electric steel.

§ 178.134-2 Construction requirements.

(a) Construction requirements are as follows:

Rated capacity of inside plastic container not over (gallons)	Minimum thickness, uncoated sheets (gauge)		Body seams	Rolling hoops	Top or bottom head	Closures, when full removable head is used (gaskets not required)
	Body sheet	Head sheet				
5	26	26	Welded	None required	Double seamed	Lug or plain ring seal.
15	24	24	do	Rolled or swedged	do	Do.
30	24	24	do	do	do	Bolted type ring closure, 18 gauge.
55	24	24	do	do	do	Bolted type ring closure, 16 gauge.

(b) Steel sheets or parts of specified gauges shall comply with the following:

Gauge No.	Nominal thickness[1] (inch)	Minimum thickness[1] (inch)
16	0.0598	0.0533
18	.0478	.0428
24	.0239	.0209
26	.0179	.0159

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

(c) Two holes not exceeding ¼ inch each are permitted diametrically opposite each other in the overpack body immediately above the double seam of the bottom chime and three holes not exceeding $\frac{3}{16}$ inch in diameter on centers 120 degrees apart in the bottom head.

(1) Overpack interior shall be free of projections, burrs, or any edges that might cause damage to inside plastic container and shall be free of lubricants, oils, or any foreign matter.

(2) Top head may have not more than two holes of suitable size to provide for protruding closures.

(3) Overpack shall be constructed to provide snug fit for inside plastic container.

§ 178.134-3 Tests.

(a) Steel overpack when assembled as for use, shall withstand the tests prescribed, in specifications for inside plastic containers as detailed in Part 178 when authorized as combination packages in Part 173 of this chapter. The completed package must withstand these tests without producing a condition of the overpack that could result in potential damage to the inside container.

§ 178.134-4 Marking.

(a) Marking on each container by embossing on bottom head with raised marks with letter and figures not less than ½ inch high as follows:

(1) DOT-37M. The letters NRC located near the DOT mark to indicate "Nonreusable container."

(2) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Gauges of metal in thinnest part, rated capacity of the inside container in gallons, and year of manufacture (for example, 24-55-62). When gauge of metal in body differs from that in either head, both must be indicated with slanting line between and with guage of body indicated first (for example, 24/22-55-62 for a container having 24-gauge body and 22-gauge top head).

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.134-4 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.135 Specification 37C; steel drums.

Nonreusable container. Removable head required.

§ 178.135-1 Compliance.

(a) Required in all details.

§ 178.135-2 Rated capacity.

(a) Rated capacity as marked (see § 178.135-8). Maximum actual capacity of containers shall be not greater than rated (marked) capacity plus 5 percent or rated (marked) capacity plus 4 percent plus 1 quart whichever is the greater.

§ 178.135-3 Composition.

(a) Sheets for body and heads to be hot-rolled or cold-rolled, low carbon, open-hearth or electric steel of standard commercial quality.

§ 178.135-4 Seams.

(a) Side seams must be welded.

§ 178.135-5 Capacities, weights, type and gauges.

(a) Capacities, weights, type and gauges must be as follows:

Marked capacity not over (gal.)	Authorized gross wt. not over (lbs.)	Type of container	Minimum thickness, uncoated sheets (gauge)		
			Body sheet	Bottom head sheet [1]	Removable head sheet [2] [3]
5	80	Straight side.	28	28	26

[1] Bottom head must have three inwardly-embossed circumferential beads.

[2] Removable head must have two inwardly-embossed circumferential beads.

[3] Removable head must have not less than 16 lugs spaced not more than ¼ inch apart.

(b) Steel sheets of specified gauges shall comply with the following:

Gauge No.	Nominal thickness [1] (inch)	Minimum thickness [1] (inch)
26	0.0179	0.0159
28	0.0149	0.0129

[1] Thickness shall be measured at any point on the sheet not less than ⅜ inch from an edge.

§ 178.135-6 Closures.

(a) Closures shall be capable of withstanding test prescribed by § 178.135-10. Removable head may be equipped with leakproof fittings for filling.

§ 178.135-7 Defective containers.

(a) Defective containers to be repaired by method used in constructing container.

§ 178.135-8 Marking.

(a) Marking on each container by embossing on the permanent head as follows:

(1) DOT-37C * * *. Stars to be replaced by the authorized gross weight, or less, at which container was type tested (for example, DOT-37C80).

(2) Gauge of metal in thinnest part rated capacity, and year of manufacture (for example, 26-5-64). When gauge of metal in body differs from that in either head, both must be indicated with slanting line between and with gauge of body indicated first (for example, 28/26-5-64) for a container having 28-gauge body, 28-gauge bottom head, and 26-gauge removable head.

(3) Name or symbol of person making the marks specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(4) The letters NRC; located near the DOT mark to indicate "nonreusable container."

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.135-9 Size of markings.

(a) Size of markings, not less than ½ inch for all containers.

§ 178.135-10 Type test.

(a) Samples, taken at random and closed as for use, shall withstand prescribed test without leakage. Tests to be made of each type and size by each company starting production and to be repeated every four months. Samples last tested to be retained until further tests are made. The type test is as follows:

(b) Test by dropping on top chime, or other part considered to be weaker, with drum filled to normal loading depth and to the gross weight at which container is marked with dry powdered material, and topped with at least two inches of a finely divided, dry, free-flowing powder of the following sieve analysis:

Percent retained on 42 mesh—Trace (maximum).

Percent retained on 50 mesh—3 percent (maximum).

Percent retained on 100 mesh—88 percent (minimum).

(c) A material such as sodium bicarbonate is recommended. Container shall be dropped from a height of 4 feet onto solid concrete so as to strike diagonally on the chime. Closing devices and other parts projecting beyond chime or rolling hoops must be capable of withstanding this test. No disc or material other than regular gaskets in closure part is permitted for test purposes.

§ 178.137 Specification 37D; steel drum. Nonreusable container. Open-head not authorized.

[Amdt. 178-10, 35 FR 5550, Apr. 3, 1970]

§ 178.137-1 General requirements.

Each drum must meet the applicable requirements of § 173.24 of this chapter.

[Amdt. 178-10, 35 FR 5550, Apr. 3, 1970]

§ 178.137-2 Rated capacity.

(a) Rated capacity is 55 gallons, as marked (see § 178.137-6).

(b) Actual capacity must be the rated capacity plus 4-5 percent.

[Amdt. 178-10, 35 FR 5550, Apr. 3, 1970]

§ 178.137-3 General construction requirements.

(a) *Chime reinforcement.* The top and bottom chimes must be reinforced with a steel band that is an integral part of the double seam and which provides a chime cross section containing at least eight layers of steel. The reinforcing band must follow and support the knuckle radius of the head with the inside edge upturned so that the edge does not contact the adjacent portions of the head.

(b) *Seams.* The body side seam must be welded.

(c) *Sidewall construction.* A continuous series of parallel, geometrically similar circumferential beads must be expanded in the drum sidewalls so that the surface length of the steel in the axial direction does not change more than 1 percent during forming.

(d) *Steel thickness.* (1) The thickness of the body and heads of the finished drum must be at least 23-gauge.

(2) The chime reinforcement must be made of at least 18-gauge steel.

(e) *Heads.* Heads must be flat. Open-head drums are not authorized.

[Amdt. 178-10, 35 FR 5550, Apr. 3, 1970]

§ 178.137-4 Closure.

(a) The closing part (plug, cap, plate, etc.) must be of steel at least 23-gage thickness, or other material of equivalent strength. Gaskets are required. Cap seals may be placed over the closure.

(b) For closures with threaded plug or cap, the seat (e.g., flange) for the plug or cap must have three or more threads. Two drainage holes of not over 5/16-inch diameter are authorized. The plug or cap must have a sufficient length of thread to engage at least three threads when securely tightened with the gasket in place.

(c) The maximum permitted closure opening is 2.7 inches in diameter.

[Amdt. 178-10, 35 FR 5550, Apr. 3, 1970]

§ 178.137-5 Defective drums.

Defects or damage must be repaired by the method used in constructing the drum. Soldering is not authorized.

[Amdt. 178-10, 35 FR 5551, Apr. 3, 1970]

§ 178.137-6 Marking.

(a) Marking must be as prescribed in § 173.24 of this chapter.

(b) The marking on each drum must be by embossing on the bottom head with raised marks as follows: "DOT-37D NRC"; and the gauge of the metal of the drum in the thinnest part, the rated capacity of the drum in gallons, and the year of manufacture (e.g., 23-55-70). When the gauge of the metal in the drum wall differs from that in the head, both must be indicated with a slanting line between, and with the gauge of the wall indicated first (e.g., 23/22-55-70).

(c) The minimum height of the letters and numerals shall be three-fourths inch.

(d) The depth of embossing must be at least 0.015 inch and not more than 0.025 inch, but in no case may the depth exceed the thickness of the metal sheet being embossed. The dies used to form the embossing marks must be free of sharp edges or corners that might cause a stress riser in the mark. The embossing marks must be at least 4 inches from the outside edge of the chime.

[Amdt. 178-10, 35 FR 5551, Apr. 3, 1970]

§ 178.137-7 Tests.

(a) Each drum must be capable of withstanding the prescribed tests without leakage of contents.

(b) Samples which are taken at random and closed as for use must be tested as prescribed in paragraphs (a)(1) and (2) of this section without leakage. Tests are to be made of each type and size by each manufacturer starting production and are to be repeated at least every 4 months thereafter. The samples last tested must be retained by the manufacturer until further tests are made or for 1 year, whichever period is shorter.

(1) *Drop test.* Test by dropping, filled with water to 98 percent capacity, from a height of 4 feet onto a solid unyielding surface (e.g., concrete or steel) so as to strike the surface diagonally on the chime. Additional similar drops must be made on any other parts of the drum which might be considered weaker than the chime. Closing devices and other parts projecting beyond the chime or sidewall beads must also be capable of withstanding this test.

(2) *Pressure test.* Hydrostatic pressure test of at least 15 pounds per square inch, sustained without pressure drop for at least 5 minutes.

(c) *Leakage test.* Each drum must be tested for leakage with seams under water, or covered with soapsuds or heavy oil, or equivalent material. Interior air pressure of at least 7 pounds per square inch must be applied, and the seams and chimes examined for evidence of leakage. Leaking drums must be rejected, or repaired (see § 178.137-5) and retested.

[Amdt. 178-10, 35 FR 5551, Apr. 3, 1970]

§ 178.141 Specification 13A; metal drums.

§ 178.141-1 Compliance.

(a) Required in all details.

§ 178.141-2 Type.

(a) Straight sided; authorized only for material cast solid and with filling end head applied after material is loaded and closed in the manner prescribed in § 178.141-6. No other openings permitted.

§ 178.141-3 Composition.

(a) To be low carbon, open-hearth or electric steel.

§ 178.141-4 Heads and body.

(a) *Heads.* To be not less than 28-gauge United States standard.

(b) *Body.* To be not less than 28-gauge United States standard.

§ 178.141-5 Seams.

(a) Must be welded.

§ 178.141-6 Heads.

(a) To be attached by means of double-lapped seam.

§ 178.141-7 Marking.

(a) Marking on each container by embossing on head with raised marks as follows:

(1) DOT-13A.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

(3) Size of markings (minimum): 5/16 inch high.

[Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.141-8 Type tests.

(a) Drum filled and closed as for shipment must be capable of withstanding, without rupture, 4 successive drops of 4 feet on the head onto solid concrete.

(b) Drum must be capable of withstanding hydrostatic pressure test of 30 pounds per square inch, sustained for 5 minutes.

(c) Tests to be made of each type and size by each company manufacturing this type of container and to be repeated every 6 months while in production. If production is discontinued and is resumed, this requirement will also apply if prescribed tests have not been made within the previous 6-month period. Samples last tested to be retained until further tests are made or for 1 year, whichever period is shorter.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5756, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.146 Specification 32A; metal cases, riveted or lock-seamed.

§ 178.146-1 Compliance.

(a) Required in all details.

§ 178.146-2 Gauge standards.

(a) United States standards for sheet metal; American or Brown and Sharpe for wire.

§ 178.146-3 Covers.

(a) To have at least 1" lap on body and to fit with clearance not over 1/32"; lapped corners to be welded.

§ 178.146-4 Edge protection.

(a) Open edges of body must be turned or rolled inward; front open edge of cover must be turned or rolled outward. Not required for material at least 20-gauge thick or for "trailer" cases.

§ 178.146-5 Bottom protection.

(a) Face on which case will ordinarily rest must be reinforced with continuous angle straps, or be fitted with trunk corners, or be double thickness along edges. Not required for cases of at least 20-gauge metal or of not over 1 reel capacity or for "trailer" cases.

§ 178.146-6 Hinges.

(a) To be of continuous loop type with loops of steel wire at least 7-gauge, welded; hinge straps at least 18-gauge securely welded or riveted.

§ 178.146-7 Carrying handles.

(a) Any type of adequate strength.

§ 178.146-8 Closing devices.

(a) To be of sufficient strength and efficiency to prevent injury or unfastening in tests (§ 178.146–14) or in transit.

§ 178.146–9 Rivets.

(a) At least 5/32" diameter; length to furnish efficient heads; split rivets not authorized except for attachment of lining.

§ 178.146–10 Rivet reinforcement.

(a) Hinges, fastening devices, and handles, when riveted in place, must have additional inside reinforcement of steel, at least as thick as in case, through which rivets must pass. Not required when case is made of at least 20-gauge material throughout.

§ 178.146–11 Lining.

(a) Required throughout; to be hard-surfaced fiberboard at least 0.125" thick and with strength of 800 pounds, Mullen or Cady test, or wooden lining at least 0.25" thick.

§ 178.146–12 Metal partitions.

(a) Metal partitions (when used) to be as thick as body of case, permanently fastened to the case, and lined the same as the case.

§ 178.146–13 Protective coating.

(a) Steel cases must be of galvanized material or protected from corrosion by paint, lacquer, or other adequate coating.

§ 178.146–14 Type tests.

(a) Cases completely filled as for shipment must be capable of withstanding 4 successive drops onto solid concrete from a height of 6 feet without rupture of case or permanent damage to or unfastening of closing device. Tests to be made by dropping on cover, seam, or any corner.

§ 178.146–15 Marking.

(a) Marking on each container by the maker with plain and permanent marks at least ½" high as follows:

(1) DOT-32A.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–40, 41 FR 38181, Sept. 9, 1976]

§ 178.146–16 Cases with capacity (approx.) not over 9,000 feet of 1⅜" film.

(a) Compliance with §§ 178.146–1 to 178.146–15 required. Seams to be lock-seams or riveted. Material to be steel, at least 20 gauge, 2 hinges, 1 fastening device, and 1 carrying handle required.

§ 178.146–17 Cases with capacity (approx.) not over 8,000 feet of 1⅜" film or 4,500 feet of 2½" film.

(a) Construction as in § 178.146–16, except: 22-gauge material authorized; 1 hinge authorized for single-reel cases.

§ 178.146–18 Cases with capacity not over 1 reel of 10" diameter.

(a) Construction as in § 178.146–16, except: 24-gauge material and 1 hinge authorized.

§ 178.146–19 Cases with capacity not over 500 feet of film, "Trailer Cases".

(a) Construction as in § 178.146–16, except: 26-gauge material and 1 hinge of any type authorized.

§ 178.147 Specification 32B; metal cases, welded or riveted.

§ 178.147–1 Compliance.

(a) Required in all details.

§ 178.147–2 Gauge standards.

(a) United States standard for sheet metal; American or Brown and Sharpe for wire.

§ 178.147–3 Covers.

(a) To have at least 1" lap on body and to fit with clearance not over 1/32"; lapped corners to be welded.

§ 178.147–4 Edge protection.

(a) Open edges of body must be turned or rolled inward; front open edge of cover must be turned or rolled outward. Not required for material at least 20-gauge thick or for "trailer" cases.

§ 178.147-5 Bottom protection.

(a) Face on which case will ordinarily rest must be reinforced with continuous angle straps, or be fitted with trunk corners, to be double thickness along edges. Not required for cases of at least 20-gauge metal or of not over 1 reel capacity or for "trailer" cases.

§ 178.147-6 Hinges.

(a) To be of continuous loop type with loops of steel wire at least 7-gauge, welded; hinge straps at least 18-gauge securely welded or riveted.

§ 178.147-7 Carrying handles.

(a) Any type of adequate strength.

§ 178.147-8 Closing devices.

(a) To be of sufficient strength and efficiency to prevent injury or unfastening in tests (§ 178.147-14) or in transit.

§ 178.147-9 Rivets.

(a) At least 5/32" diameter; length to furnish efficient heads; split rivets not authorized except for attachment of lining.

§ 178.147-10 Rivet reinforcement.

(a) Hinges, fastening devices, and handles, when riveted in place, must have additional inside reinforcement of steel, at least as thick as in case, through which rivets must pass. Not required when case is made of at least 20-gauge material throughout.

§ 178.147-11 Lining.

(a) Required throughout; to be hard-surfaced fiberboard at least 0.125" thick and with strength of 800 pounds, Mullen or Cady test, or wooden lining at least 0.25" thick.

§ 178.147-12 Metal partitions.

(a) Metal partitions (when used) to be as thick as body of case, permanently fastened to the case, and lined the same as the case.

§ 178.147-13 Protective coating.

(a) Steel cases must be of galvanized material or protected from corrosion by paint, lacquer, or other adequate coating.

§ 178.147-14 Type tests.

(a) Cases completely filled as for shipment must be capable of withstanding 4 successive drops onto solid concrete from a height of 6 feet without rupture of case or permanent damage to or unfastening of closing device. Tests to be made by dropping on cover, seam, or any corner.

§ 178.147-15 Marking.

(a) Marking on each container by the maker with plain and permanent marks at least ½" high as follows:

(1) DOT-32B.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with Associate Director for OE.

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.147-16 Cases with capacity (approximate) not over 12,000 feet of 1⅜" film or 6,000 feet of 2½" film.

(a) Compliance with §§ 178.147-1 to 178.147-15 required. Seams to be welded or riveted. Material to be steel, or aluminum-manganese alloy, at least 18-gauge, 2 hinges, 2 fastening devices spaced as for hinges, and 2 carrying handles required.

§ 178.147-17 Cases with capacity (approximate) not over 9,000 feet of 1⅜" film.

(a) Compliance with §§ 178.147-1 to 178.147-16, except: 1 fastening device and 1 carrying handle authorized.

§ 178.147-18 Cases with capacity (approximate) not over 8,000 feet of 1⅜" film or 4,500 feet of 2½" film.

(a) Construction as in § 178.147-16, except: 20-gauge material, 1 fastening device, and 1 carrying handle authorized; 1 hinge authorized for single-reel cases. Detachable covers (no hinges) with ¾" lap on body and efficiency to prevent displacement in tests, are authorized. Trailer cases, capacity not over 500 feet of film, no handle required. Cover lap not less than full one-half inch.

§ 178.148 Specification 32C; metal trunks.

§ 178.148–1 Design.

(a) To be designed to contain film in film-reel cans and projecting apparatus only; other articles not authorized therein.

§ 178.148–2 Strength.

(a) To be of strength and efficiency to carry contents in ordinary handling without damage to trunk or contents.

§ 178.148–3 Compartments.

(a) Separate compartments required for each reel of film and for projecting apparatus; each compartment to be constructed so that, in closing, it will have no cracks or openings.

§ 178.148–4 Compartment linings.

(a) Each film compartment to be made of, or lined throughout with, sheet metal; this metal to be protected against contact with film-reel can by a substantial interlining of fiberboard or equivalent.

§ 178.148–5 Marking.

(a) Marking on each container by the maker with plain and permanent marks at least ½" high applied on 2" by 4" metal plate securely riveted to top of cover of trunk as follows:

(1) DOT-32C.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–40, 41 FR 38181, Sept. 9, 1976]

§ 178.149 Specification 32D; metal boxes for old and worn-out motion-picture film no longer exhibitable.

§ 178.149–1 Compliance.

(a) Required in all details.

§ 178.149–2 Gauge standards.

(a) United States standard for sheet metal; American or Brown and Sharpe for wire.

§ 178.149–3 Material.

(a) Material to be steel; body and bottom at least 16-gauge; cover at least 18-gauge.

§ 178.149–4 Joints and seams.

(a) All joints and seams to be welded or riveted.

§ 178.149–5 Cover.

(a) Cover must be tight-fitting, to prevent entrance of sparks, with provision for secure fastening to be locked or sealed.

§ 178.149–6 Type tests.

(a) Cases completely filled as for shipment must be capable of withstanding 4 successive drops onto solid concrete from a height of 4 feet without rupture of case or permanent damage to or unfastening of closing device. Tests to be made by dropping on cover, seam, or any corner.

§ 178.149–7 Marking.

(a) Marking on each container by the maker with plain and permanent marks at least ½" high as follows:

(1) DOT-32D.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18893, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–40, 41 FR 38181, Sept. 9, 1976]

§ 178.150 Specification 33A; polystyrene cases. Nonreusable containers.

§ 178.150–1 Material requirements.

(a) Expandable polystyrene, molded to produce a completely fused closed cell composition having a minimum density of 1.25 pounds per cubic foot.

§ 178.150–2 Design.

(a) The case is to consist of two parts, a bottom section with pockets for the inside containers and a top section that covers, and interlocks with the bottom section. Both the bottom and top sections shall be designed to provide a snug fit for the inside containers.

§ 178.150–3 Construction.

(a) The case shall be constructed in accordance with the following minimum thicknesses:

(1) Multiple bottle cases, not more than four individual bottles per case;

	Nominal capacity of individual inside containers	
	5 pints	1 gallon
Sidewall and bottom, inches	¾	1
Between inside containers, inches	⅝	⅝
Top, inches (see Note 1)	¾	1

NOTE 1: In recess for closure cap for inside container, ¼-inch thickness is permissible: closure cap shall not be in contact with inside of top section.

(2) Single bottle cases:

	Nominal capacity of inside containers			
	Pint	Quart	5 pts.	Gallon
Side wall, inches	⅝	⅝	¾	1½
Top wall, inches	¾	¾	¾	1
Bottom wall, inches	1	1	¾	1½

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–3, 34 FR 7164, May 1, 1969]

§ 178.150–4 Closing for shipment.

(a) Cases shall be closed for shipment with a pressure-sensitive tape having a tensile strength of not less than 55 pounds per inch of width or tape of equivalent strength. The tape shall completely encircle the case, with overlap of not less than 1 inch, in one direction so as to transverse the joint of the two sections perpendicularly. If the design of the case is such that the tape is subject to abrasion in transportation and handling, tape shall also be applied similarly on the same axis, but at 90°.

(1) For multiple bottle case, tape width shall not be less than 1¼ inches.

(2) For single bottle case, tape width shall not be less than three-fourths inch.

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.150–5 Gross weight authorized.

(a) Multiple bottle case, 60 pounds maximum.

(b) Single bottle case, 20 pounds maximum.

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.150–6 Test for completed package.

(a) Cases, with inside containers filled with water enclosed as for shipment, shall be capable of withstanding 4-foot flap drops onto solid concrete without leakage from or breakage of any inside container, and without producing any condition that would result in potential damage to the inside container. A minimum of four cases shall be tested, each case not being subjected to more than one test. Each test is to consist of six 4-foot drops once each side, bottom and top.

(b) Tests prescribed by paragraph (a) of this section must be conducted by the shipper assembling the completed package prior to initial use, and each 6 months thereafter. The tests must also be repeated on the change of any components or design of the package. Records of tests and results must be maintained for at least 1 year.

[29 FR 18893, Dec. 29, 1964, as amended by Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1976]

§ 178.150–7 Marking.

(a) Each container must be marked as follows:

(1) DOT-33A.

(2) The letters "NRC", located just above or below the DOT mark, to indicate a nonreusable container.

(3) Name or symbol of person making the other marks specified in this section and located on the same face as those other marks. Symbol, if used, must be registered with the Associate Director for OE.

(4) Size of markings: Specification markings prescribed in this section must be at least ¼ inch high. All markings must be legible.

[Amdt. 178–40, 41 FR 38182, Sept. 9, 1976]

Subpart E—Specifications for Wooden Barrels, Kegs, Boxes, Kits, and Drums

Source: 29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967.

§ 178.156 Specification 10B; wooden barrels and kegs (tight).

§ 178.156–1 Compliance.

(a) Required in all details.

§ 178.156–2 Staves and heading.

(a) To be of white oak, chestnut oak, red oak, black cherry, Douglas fir, beech, sweet birch, yellow birch, sugar (hard) maple, or Scandinavian pine; quarter sawed with the grain, from straight-grained timber, so no annual ring shall slope over half the thickness of stave or head; thoroughly kiln dried, moisture content 7 percent to 11 percent; free from rotten sap, checks, pitch pockets, cat faces, seed and worm holes in excess of 15 in one container, and other defects that show through on both sides.

§ 178.156–3 Hoops.

(a) To be of cooperage-grade hoop steel.

§ 178.156–4 Staves.

(a) Staves to be sawed evenly and circular; croze center to be within 1⅛" of end of stave; stave end to have ⅛" free from bevel.

§ 178.156–5 Heading.

(a) Heading of uniform thickness and properly circled; planed on outside and properly jointed and glued, or doweled and flagged; dowel diameter not over 5/12" thickness of head.

§ 178.156–6 The barrel.

(a) Stave joints reasonably flush on outside. Lathing is forbidden.

(b) Worm and seed holes to be plugged; over 15 not authorized in one container.

§ 178.156–7 Parts required and dimensions.

(a) Parts required and dimensions as follows (10 percent excess capacity authorized):

(1) Staves, when finished on outside:

Capacity of container, not over (gallons)	Maximum			Minimum	
	Length (inches)	Width (inches)	Bilge circle (inches)	Staves (number)	Thickness (inches)
50	34	6	84	19	1 1/16
30	30	5	74	16	⅝
15	24	4½	54	14	9/16
10	22	4¼	50	12	½
5	18	4	40	10	½

Foregoing thicknesses are of staves finished on one side. One-sixteenth inch must be added for unfinished staves.

Foregoing maximum lengths are authorized to be increased 6 percent or less, provided the thickness of stave is increased at least one-sixteenth inch for each increase of 1 inch in length or fraction thereof.

(2) Heading, after planning:

Capacity of container, not over (gallons)	Maximum		Minimum	
	Pieces (number)	Diameter (inches)	Thickness (inches)	Width (inches)
50	6	21	¾	2½
30	6	18	⅝	2½
15	5	14	9/16	2
10	5	13	½	2
5	4	11	½	2

Note 1: Because of the present emergency and until further order of the Department, for barrels of not over 50 gallons capacity, maximum number of pieces may be 7 provided they have a minimum thickness of ⅞ inch.

(3) Hoops, number and size:

Capacity of container, not over (gallons)	Minimum number of hoops	Minimum size of hoops (inches) in width and Birmingham gauge							
		Head		First quarter		Second quarter		Bilge	
		Inch	Gauge	Inch	Gauge	Inch	Gauge	Inch	Gauge
50	[1]8	[3]1¾	[3]17	1½	18	1½	18	[3]1¾	[3]17
30	6	1½	18	1¼	19			1½	18
15	6	1¼	19	1⅛	19			1¼	19
10	6	1⅛	19	1	19			1⅛	19
5	[2]6	1	19	1	19			1	19

[1] Because of the present emergency and until further order of the Department, the minimum number of hoops is authorized to be reduced to 6 by eliminating second quarter hoops.

[2] Because of the present emergency and until further order of the Department, the minimum number of hoops is authorized to be reduced to 4 by eliminating first quarter hoops if head and bilge hoops of 1¾ inch by 17 gauge are used.

[3] 2 inch by 18 gauge hoops are also authorized.

§ 178.156–8 Closures.

(a) To be such as to prevent leakage in transit. Bungholes in staves must be not over 2" diameter.

§ 178.156–9 Lining.

(a) To be as prescribed in Part 173 of this chapter or otherwise appropriate for the contents.

§ 178.156–10 Type test.

(a) Sample container at least 2 days old shall not increase more than 10 percent on diameter of head when all hoops above bilge are removed.

§ 178.156–11 Leakage test.

(a) Required for each lined container by pressure at time of sizing or air pressure of at least 5 pounds per square inch; leakers to be repaired and retested.

§ 178.156–12 Marking.

(a) Marking on each container by the maker. By hot branding iron on head as follows:

(1) DOT-10B.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) Date of manufacture (for example, 7-50 for July 1950) located near the maker's mark.

NOTE 1: Because of the present emergency and until further order of the Department, date of manufacture may be omitted.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967 and amended by Amdt. 178–21, 36 FR 18469, Sept. 15, 1971; Amdt. 178–40, 41 FR 38181, Sept. 9, 1976]

§ 178.156–13 Size of markings.

(a) Size of markings (minimum): ¾" high for over 30-gallon size, ½" for others.

§ 178.165 Specification 14; wooden boxes, nailed.

§ 178.165–1 Compliance.

(a) Required in all details.

§ 178.165–2 Lumber.

(a) White pine or wood of at least equal strength, well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within one-half its length.

§ 178.165–3 Nails.

(a) Cement coated, except as otherwise authorized, or screws of equal efficiency.

§ 178.165–4 Ends, sides, tops, and bottoms.

(a) Ends, sides, tops, and bottoms as follows:

(1) Parts of 1-piece.

(2) Parts Linderman-joint glued.

(3) Parts tongued, grooved, and glued.

(4) Parts butt-joint glued, provided the joined surfaces are planed before gluing so as to assure full contact. After immersion in water for 24 hours at 70° F, the part must not fail at the joint when it is broken.

(b) Tongued, grooved and glued joints in uncleated ends must also be fastened with corrugated fasteners not over 8" apart, within 3" of each end of joint and having penetration ⅘ thickness of end.

§ 178.165–5 Cleated ends.

(a) Double cleated, 2 vertical and 2 horizontal. Nails staggered at 2" intervals and clinched; cement coating not required.

§ 178.165–6 Sides, tops, and bottoms.

(a) Of size to extend out over cleats, if any.

§ 178.165–7 Lock and dovetail corners.

(a) Glued.

§ 178.165–8 Parts and dimensions.

(a) Parts and dimensions as follows:

Authorized gross weight (maximum) (pounds)	Type of box	Thickness of lumber (minimum)				Nails (minimum size)[4]	
		Ends[3] (inches)	Sides (inches)	Tops and bottoms[2] (inches)	Cleats (inches)	Into ends or cleats (penny)	Into sides (penny)
35	Lock[1] Corner	7/16	7/16	5/16		5d	5d
65	Lock[1] Corner	½	½	⅜		5d	5d
75	Plain Nailed	⅞	½	½		7d	5d
75	Double Cleat	⅜	⅜	⅜	½×1½	5d	
140	Plain Nail	1⅛	⅝	⅜		8d	7d
140	Lock[1] Corner	⅝	⅝	⅝		7d	7d
140	Double Cleat	¾	⅝	⅝	¾×1⅞	7d	7d

[1] Or dovetail.

[2] Tops and bottoms may be made of paper covered veneer board of good quality Douglas fir, or lumber of equal quality, having minimum thickness of ⅛ inch and free from decay, objectionable knots that interfere with nailing, splits, gaps, and other defects that materially lessen the strength. Paper covering shall be at least Kraft untreated liner-board having a basis weight of 42 pounds per 1,000 square feet and shall be secured to veneer core by adhesive in such manner as to form a satisfactorily laminated board. Board ends must be provided with such reinforcement as may be necessary to provide strength for nailing.

[3] As provided by § 173.65(a)(1), Note 1, of this chapter, boxes, having inside metal containers which are tightly and securely closed, may be equipped with hand holes in each end which must be not more than one inch by four inches and centered laterally not nearer than 1⅝ inches from top edge of end of box.

[4] Coated wire staples are authorized in lieu of nails when used for fastening tops to boxes. Staples must be of such size and spaced and driven as to provide closure efficiency equivalent to that in §§ 178.165–11 and 178.165–12.

§ 178.165–9 Joints in sides and ends.

(a) Staggered; except for ends cleated as prescribed.

§ 178.165–10 Tops and bottoms.

(a) Must fit evenly on frame of box.

§ 178.165–11 Cleated boxes.

(a) Sides, top, and bottom must be secured to ends by nails driven into cleats, not into end boards.

§ 178.165–12 Nails in each nailing edge (minimum numbers).

(a) At least equal to length of edge in inches divided by 2; when number of nails is at least equal to length of edge divided by 1¾, 4d nails are authorized where 5d nails are prescribed.

Exception: Eight inch spacing authorized for nailing tops and bottoms to sides.

NOTE 1: Because of the present emergency and until further order of the Department, the following exception is authorized for nailing tops to boxes: When 7d and 8d nails are required by § 178.165–8, 6d nails are authorized if number of nails used is at least equal to length of end edge divided by 1¾ and length of side edge divided by 6.

§ 178.165–13 Marking.

(a) Marking on each box with letters and figures at least ½" high in rectangle as follows:

DOT-14

(b) Each box must also be marked with the name or symbol of person making the mark specified in paragraph (a) of this section. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.168 Specification 15A; wooden boxes, nailed.

§ 178.168–1 Compliance.

(a) Required in all details.

§ 178.168–2 Closed[1] box.

(a) Parts and pieces to be in close contact.

§ 178.168–3 Ends.

(a) One-piece, or equivalent (see § 178.168–5), or cleated as prescribed; joints tongued, grooved, and glued Style 1 or style 6 boxes may have milled depressions in each end of box for hand-holds, of not more than ⅜ inch in depth and not exceeding one-third of the width of the box, only when ends are of lumber at least ¾ inch in thickness.

(b) As provided by § 173.65(a)(1), Note 1, of this chapter, wooden boxes having inside metal containers which are tightly and securely closed, may be equipped with hand holes in each end which must be not more than one inch by four inches and centered laterally not nearer than 1⅝ inches from top edge of end of box.

§ 178.168–4 Sides, top, and bottom.

(a) Joints tongued, grooved, and glued, or one-piece equivalent, except that boxes for shipment of high explosives may have tops and bottoms made of paper-covered veneer board of good quality Douglas fir, or lumber of equal quality, having minimum thickness of ⅛ inch and free from decay, objectionable knots that interfere with nailing, splits, gaps, and other defects that materially lessen the strength. Papers covering shall be at least kraft untreated linerboard having a basis weight of 42 pounds per 1,000 square feet and shall be secured to veneer core by adhesive in such manner as to form a satisfactorily laminated board. Board ends must be provided with such reinforcement as may be necessary to provide strength for nailing, and when used lumber thicknesses specified by § 178.168–12 do not apply.

§ 178.168–5 One-piece equivalents.

(a) Parts are considered equivalent to one-piece as follows:

(1) Parts Linderman-joint glued.

(2) Parts at least ½" thick, tongued and grooved and glued, with 2 or more corrugated fasteners on each joint.

(3) Parts butt-joint glued, provided the joined surfaces are planed before gluing, so as to assure full contact. After immersion in water for 24 hours at 70° F. the part must not fail at the joint when it is broken.

(b) Corrugated fasteners (as prescribed for one-piece equivalents): 1" wide; penetration ⅓ thickness of part; within 3" of end of joint and not over 8" apart; for 3 or more, drive alternately into opposite sides of part.

§ 178.168–6 Gluing efficiency.

(a) Shall be determined for boxes for gross weight of 150 pounds or less. When filled with sand and sawdust to marked gross weight, the boxes must be able to withstand 8 drops of 12", one on each corner, onto solid concrete without exposure of contents.

§ 178.168–7 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots that would interfere with nailing, and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleats within ½ its length.

§ 178.168–8 Nails.

(a) Cement coated, unless otherwise authorized herein, of size specified for "sinkers" and "coolers" as generally known to the trade.

§ 178.168–9 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.
Norway pine.
Aspen (popple).
Spruce.
Western (yellow) pine.
Cottonwood.
Balsam fir.
Yellow poplar.
Cedar.
Redwood.
Butternut.
Cucumber.
Chestnut.
Sugar pine.
Cypress.
Basswood.

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[1] Openings for filling device of inside container authorized if device is properly protected.

Willow.
Noble fir.
Magnolia.
Buckeye.
White fir.
Alpine fir.
Lodgepole pine
Jack pine.

GROUP 2

Southern yellow pine.
Hemlock.
North Caroline pine.
Douglas fir.
Larch (tamarack)

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black gum.
Black ash.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
Hickory.
White ash.

§ 178.168-10 Width of pieces.

(a) At least 2½″.

§ 178.168-11 Width of cleats.

(a) Twice the prescribed thickness plus ¾″.

§ 178.168-12 Thickness of lumber.

(a) Nailed boxes not cleated (Style 1). Authorized gross weight not over 100 pounds, see Note 1. Sides as in Table 1; top and bottom as in Table 1A; ends as in Table 5.

(b) Glued-lock-corner boxes (Style 6). Authorized gross weight not over 150 pounds. Sides as in Table 3; top and bottom as in Table 1A; ends as in Table 3A. Or, sides as in Table 2; top and bottom as in Table 1A; end as in Table 4.

(c) Singled-cleated boxes (Style 4 or 5). Authorized gross weight not over 200 pounds, see Note 2. Sides as in Table 1; top and bottom as in Table 1A; ends and cleats as in Table 3A.

(d) Double-cleated boxes (Style 2, 2½, or 3). Authorized gross weight not over 500 pounds. See Note 3. Sides as in Table 1; top and bottom as in Table 1A; end and cleats as in Table 2A. Or, sides as in Table 1; top and bottom as in Table 1A; cleats as in Table 3B; ends not thinner than thickest side or top.

NOTE 1: When group 2 woods are used the gross weight may be increased to 110 pounds.

NOTE 2: When group 2 woods are used the gross weight may be increased to 220 pounds.

NOTE 3: When group 2 woods are used the gross weight may be increased to 550 pounds.

(e) Tables are as follows (dimensions of materials finished or resawed):

TABLE 1

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	5/16	5/16	5/16	5/16	5/16	5/16
25	5/16	5/16	5/16	5/16	5/16	5/16
35	5/16	5/16	5/16	5/16	5/16	5/16
45	11/32	11/32	11/32	11/32	11/32	11/32
55	3/8	11/32	11/32	11/32	11/32	11/32
65	3/8	3/8	11/32	11/32	11/32	11/32
75	7/16	3/8	3/8	11/32	11/32	11/32
85	7/16	7/16	3/8	3/8	11/32	11/32
100	1/2	7/16	7/16	3/8	3/8	11/32
125	9/16	1/2	1/2	7/16	3/8	3/8
150	5/8	9/16	9/16	1/2	7/16	3/8
175	5/8	5/8	9/16	1/2	1/2	7/16

TABLE 1—Continued

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
200	11/16	5/8	5/8	9/16	1/2	7/16
250	25/32	3/4	11/16	5/8	9/16	1/2
300	13/16	13/16	3/4	11/16	5/8	9/16
350	15/16	7/8	13/16	3/4	11/16	5/8
400	1	15/16	7/8	13/16	3/4	11/16
500	1 1/8	11/16	1	15/16	7/8	3/4

TABLE 1A

Authorized gross weight (pounds)	Width of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	5/16	5/16	5/16	5/16	5/16	5/16
25	5/16	5/16	5/16	5/16	5/16	5/16
35	5/16	5/16	5/16	5/16	5/16	5/16
45	11/32	11/32	11/32	11/32	11/32	11/32
55	3/8	11/32	11/32	11/32	11/32	11/32
65	3/8	3/8	11/32	11/32	11/32	11/32
75	7/16	3/8	3/8	11/32	11/32	11/32
85	7/16	7/16	3/8	3/8	11/32	11/32
100	1/2	7/16	7/16	3/8	3/8	11/32
125	9/16	1/2	1/2	7/16	3/8	3/8
150	5/8	9/16	9/16	1/2	7/16	3/8
175	5/8	5/8	9/16	1/2	1/2	7/16
200	11/16	5/8	5/8	9/16	1/2	7/16
250	25/32	3/4	11/16	5/8	9/16	1/2
300	13/16	13/16	3/4	11/16	5/8	9/16
350	15/16	7/8	13/16	3/4	11/16	5/8
400	1	15/16	7/8	13/16	3/4	11/16
500	1 1/8	11/16	1	15/16	7/8	3/4

TABLE 2

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	11/32	11/32	11/32	11/32	11/32	11/32
35	3/8	11/32	11/32	11/32	11/32	11/32
45	7/16	3/8	3/8	11/32	11/32	11/32
55	1/2	7/16	3/8	3/8	11/32	11/32
65	1/2	1/2	7/16	3/8	3/8	11/32
75	9/16	1/2	1/2	7/16	3/8	3/8
85	9/16	9/16	1/2	7/16	7/16	3/8
100	5/8	9/16	9/16	1/2	7/16	7/16
125	11/16	5/8	5/8	9/16	1/2	7/16
150	3/4	11/16	11/16	5/8	9/16	1/2
175	13/16	3/4	11/16	11/16	5/8	9/16
200	7/8	13/16	3/4	3/4	11/16	5/8
250	1	15/16	7/8	13/16	3/4	5/8
300	1 1/16	1	15/16	7/8	25/32	11/16
350	1 1/8	1 1/16	1	15/16	7/8	3/4
400	1 3/16	1 1/8	1 1/16	1	15/16	13/16
500			1 1/8	1 1/16	1	7/8

TABLE 2A

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	7/16	7/16	7/16	7/16	7/16	7/16
55	1/2	7/16	7/16	7/16	7/16	7/16
65	1/2	1/2	7/16	7/16	7/16	7/16
75	9/16	1/2	1/2	7/16	7/16	7/16
85	9/16	9/16	1/2	7/16	7/16	7/16
100	5/8	9/16	9/16	1/2	7/16	7/16
125	11/16	5/8	5/8	9/16	1/2	7/16
150	3/4	11/16	11/16	5/8	9/16	1/2
175	13/16	3/4	11/16	11/16	5/8	9/16
200	7/8	13/16	3/4	3/4	11/16	5/8
250	1	15/16	7/8	13/16	3/4	5/8
300	1 1/16	1	15/16	7/8	25/32	11/16
350	1 1/8	1 1/16	1	15/16	7/8	3/4
400	1 3/16	1 1/8	1 1/16	1	15/16	13/16
500			1 1/8	1 1/16	1	7/8

TABLE 3

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	5/16	5/16	5/16	5/16	5/16	5/16
25	3/8	11/32	11/32	11/32	11/32	11/32
35	7/16	7/16	3/8	11/32	11/32	11/32
45	1/2	1/2	7/16	7/16	3/8	11/32
55	9/16	1/2	1/2	7/16	7/16	3/8
65	9/16	9/16	9/16	1/2	7/16	7/16
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 3/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 3A

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	1/2	1/2	7/16	7/16	7/16	7/16
55	9/16	1/2	1/2	7/16	7/16	7/16
65	9/16	9/16	9/16	1/2	7/16	7/16

TABLE 3A—Continued

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 5/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 3B

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	7/16	7/16	7/16	7/16	7/16	7/16
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	1/2	1/2	7/16	7/16	7/16	7/16
55	9/16	1/2	1/2	7/16	7/16	7/16
65	9/16	9/16	9/16	1/2	7/16	7/16
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16		15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 5/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 4

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	7/16	7/16	7/16	7/16	7/16	7/16
25	7/16	7/16	7/16	7/16	7/16	7/16
35	1/2	1/2	7/16	7/16	7/16	7/16
45	9/16	9/16	1/2	1/2	7/16	7/16
55	5/8	9/16	9/16	1/2	1/2	7/16
65	11/16	5/8	5/8	9/16	1/2	1/2
75	3/4	11/16	5/8	5/8	9/16	1/2
85	25/32	3/4	11/16	5/8	5/8	9/16
100	7/8	13/16	3/4	11/16	5/8	9/16
125	15/16	7/8	13/16	3/4	11/16	5/8
150	1	15/16	15/16	7/8	13/16	11/16

TABLE 5

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	½	½	½	½	½	½
25	½	½	½	½	½	½
35	⅝	9/16	½	½	½	½
45	11/16	⅝	9/16	9/16	½	½
55	¾	11/16	⅝	⅝	9/16	½
65	13/16	¾	11/16	⅝	⅝	9/16
75	⅞	13/16	¾	11/16	⅝	9/16
85	15/16	⅞	13/16	¾	11/16	⅝
100	1	15/16	⅞	13/16	¾	11/16

§ 178.168-13 Reduced thicknesses.

(a) Reduction in thicknesses is authorized as in paragraphs (a) to (d) of this section except that reduced thicknesses must be not less than:

(1) Sides, top, and bottom: Minimum 5/16″ for boxes up to 35 pounds authorized gross weight and ⅜″ above that weight.

(2) Ends or cleats: Minimum 7/16″.

(b) Sides of one-piece or equivalent 12½ percent.

(c) Any part or cleat of Group 3 or 4 wood; 20 percent.

(d) Sides, top, and bottom when to be strapped as per § 178.168-19(b); 20 percent for 1 strap; 35 percent for 2 straps.

CONVERSION TABLE

Specified thickness (inches)	Reduced thickness corresponding to percent reduction		
	12½	20	35
9/32	¼	¼	¼
5/16	9/32	¼	¼
11/32	5/16	9/32	¼
⅜	5/16	5/16	¼
7/16	⅜	11/32	9/32
½	7/16	⅜	5/16
9/16	½	7/16	⅜
⅝	9/16	½	7/16
11/16	⅝	9/16	7/16
¾	⅝	⅝	½
25/32	11/16	⅝	½
13/16	11/16	⅝	½
⅞	¾	11/16	9/16
15/16	13/16	¾	⅝
1	⅞	13/16	⅝
1 1/16	15/16	⅞	11/16
1⅛	1	⅞	¾
1 3/16	1 1/16	15/16	25/32
1¼	1⅛	1	13/16
1 5/16	1⅛	1 1/16	⅞

§ 178.168-14 Assembly.

(a) By nailing; screws, hinges and hasp, or other device of equal efficiency are authorized; nails should be driven flush.

§ 178.168-15 Nails and nailing.

(a) Cement coated of gauge and with spacing detailed in §§ 178.168-16 and 178.168-17.

(b) At cleated edges drive at least 40 percent of nails into cleats.

(c) Nails fastening cleats to be staggered and clinch ⅛″; uncoated nails authorized.

(d) Nailing tops and bottoms to sides permitted but not required.

§ 178.168-16 Nails; kind and dimensions.

(a) Cement[1] coated of gauge and length as for "sinkers" and "coolers" as generally known to the trade; size[2] in "penny" as follows:

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[1] Uncoated nails authorized when increased 25 percent in number.

[2] Nails 1-penny smaller authorized when spaced as for 2-penny smaller. Nails 2-penny smaller authorized, but not less than 3-penny when thickness of material nailed through does not exceed ½ of thickness of material holding points of nails.

Species of wood holding points of nails	Thickness of material holding points of nails (inches)										
	3/8 or less	7/16	1/2	9/16	5/8	11/16	3/4	25/32	13/16	7/8	15/16 or more
Group 1	4	5	5	6	7	7	8	8	8	9	1
Group 2	4	4	5	5	6	6	7	7	7	8	....
Group 3	3	4	4	5	5	6	6	7	7	7	....
Group 4	3	3	4	4	4	5	5	6	6	7	....

§ 178.168–17 Nail spacing.[3]

(a) Nail spacing as follows:

Nails (size)	Maximum spacing when driven into end and cleats	
	Side grain	End grains
	Inches	
Threepenny	1¼	1
Fourpenny	1½	1¼
Fivepenny	1¾	1½
Sixpenny	2	1¾
Sevenpenny	2¼	2
Eightpenny	2½	2¼
Ninepenny	2¾	2½
Tenpenny	3	2½

§ 178.168–18 Marking.

(a) Marking on each box with letters and figures at least ½" high in rectangle as follows:

DOT-15A***

(1) The stars must be replaced by authorized gross weight (for example, DOT-15A100, etc.).

(b) The words "ONE STRAP", or "TWO STRAPS", etc., when straps are required (see § 178.168-13(d); this to be placed above or below the rectangle.

(c) Marks may also be applied as follows:

DOT-15A

NO STRAP XXX LBS.

ONE STRAP XXX LBS.

TWO STRAP XXX LBS.

(1) The "X's" must be replaced by authorized gross weights as authorized for the strapping conditions.

(d) Each box must also be marked with the name or symbol of person making the other marks specified in this section. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.168–19 Closing for shipment.

(a) Box to be securely closed. Nails, if used, to be as prescribed in §§ 178.168-16 and 178.168-17.

(b) Metal straps, as specified by marks on box, must encircle sides, top, and bottom as follows:

(1) One nailless strap: At center of box.

(2) Two or more nailless straps: Outer two about ⅙ of box length from ends and other equally spaced between.

(3) Nailed straps: At ends of sides, top, and bottom; use same size nails as for closing and space not over twice as far apart.

(4) Size of flat straps must be as follows:

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[3] To determine number of nails, divide length of nailing edge by spacing; fractions greater than ½ are considered as whole numbers.

Authorized gross weight (pounds)	Cross-section size when number of straps is—		
	1	2	3
	Inches		
50	½ × 0.020	⅜ × 0.015	
100	⅝ × 0.020	½ × 0.018	
200	¾ × 0.023	⅝ × 0.020	½ × 0.018
300		⅝ × 0.023	½ × 0.020
400		¾ × 0.020	½ × 0.023
500		¾ × 0.023	⅝ × 0.023

(5) Wires, Washburn and Moen gauge, authorized as follows:

Authorized gross weight (pounds)	Gauge of wires when number of straps is—		
	1	2	3
	Inches		
50	12	14	
100	11	12	
200	9	11	12
300		10	11
400		10	11
500		9	10

§ 178.169 Specification 15B; wooden boxes, nailed.

§ 178.169-1 Compliance.

(a) Required in all details.

§ 178.169-2 Closed[1] box.

(a) Parts and pieces to be in close contact.

§ 178.169-3 Ends.

(a) One-piece, or equivalent see (§ 178.169-5); or cleated as prescribed with joints tongued and grooved.

§ 178.169-4 Sides, top, and bottom.

(a) Joints tongued and grooved, or one-piece equivalent.

§ 178.169-5 One-piece equivalents.

(a) Parts are considered equivalent to one-piece as follows:

(1) Parts Linderman-joint glued.

(2) Parts at least ½" thick, tongued and grooved and glued, with 2 or more corrugated fasteners on each joint.

(3) Parts at least ½" thick, tongued and grooved and fastened with 3 or more corrugated fasteners on each joint.

(4) Parts butt-joint glued, provided the joined surfaces are planed before gluing, so as to assure full contact. After immersion in water for 24 hours at 70° F. the part must not fail at the joint when it is broken.

(b) Corrugated fasteners (as prescribed for one-piece equivalents): 1" wide; penetration ⅘ thickness of part; within 3" of end of joint and not over 8" apart; for 3 or more, drive alternately into opposite sides of part.

§ 178.169-6 Gluing efficiency.

(a) Shall be determined for boxes for gross weight of 150 pounds or less. When filled with sand and sawdust to marked gross weight, the boxes must be able to withstand 8 drops of 12", one on each corner, onto solid concrete without exposure of contents.

§ 178.169-7 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within ½ its length.

§ 178.169-8 Nails.

(a) Cement coated, unless otherwise authorized herein, of size specified for "sinkers" and "coolers" as generally known to the trade.

§ 178.169-9 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.
Norway pine.
Aspen (popple).
Spruce.
Western (yellow) pine.
Cottonwood.
Balsam fir.
Yellow poplar.
Chestnut.
Sugar pine.
Cypress.
Basswood.
Willow.
Noble fir.
Magnolia.

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[1] Openings for filling device of inside container authorized if device is properly protected.

Buckeye.
White fir.
Cedar.
Redwood.
Butternut.
Cucumber.
Alpine fir.
Lodgepole pine.
Jack pine.

GROUP 2

Southern yellow pine.
Hemlock.
North Carolina pine.
Douglas fir.
Larch (tamarack)

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black gum.
Black ash.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
Hickory.
White ash.

§ 178.169-10 Width of pieces.

(a) At least 2½″.

§ 178.169-11 Width of cleats.

(a) Twice the prescribed thickness plus ¾″.

§ 178.169-12 Thickness of lumber.

(a) Nailed boxes not cleated (Style 1). Authorized gross weight not over 100 pounds, see Note 1. Sides as in Table 1; top and bottom as in Table 1A; ends as in Table 5.

(b) Glued-lock-corner boxes (Style 6): Authorized gross weight not over 150 pounds. Sides as in Table 3; top and bottom as in Table 1A; ends as in Table 3A. Or, sides as in Table 2; top and bottom as in Table 1A; ends as in Table 4.

(c) Single-cleated boxes (Style 4 or 5): Authorized gross weight not over 200 pounds, see Note 2. Sides as in Table 1; top and bottom as in Table 1A; ends and cleats as in Table 3A.

(d) Double-cleated boxes (Style 2, 2½, or 3): Authorized gross weight not over 500 pounds, see Note 3. Sides as in Table 1; top and bottom as in Table 1A; end and cleats as in Table 2A. Or, sides as in Table 1; top and bottom as in Table 1A; cleats as in Table 3B; ends not thinner than thickest side or top.

NOTE 1: When group 2 woods are used the gross weight may be increased to 110 pounds.

NOTE 2: When group 2 woods are used the gross weight may be increased to 220 pounds.

NOTE 3: When group 2 woods are used the gross weight may be increased to 550 pounds.

(e) Tables are as follows (dimensions of materials finished or resawed).

TABLE 1

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	5/16	5/16	5/16	5/16	5/16	5/16
25	5/16	5/16	5/16	5/16	5/16	5/16
35	5/16	5/16	5/16	5/16	5/16	5/16
45	11/32	11/32	11/32	11/32	11/32	11/32
55	3/8	11/32	11/32	11/32	11/32	11/32
65	3/8	3/8	11/32	11/32	11/32	11/32
75	7/16	3/8	3/8	11/32	11/32	11/32
85	7/16	7/16	3/8	3/8	11/32	11/32
100	1/2	7/16	7/16	3/8	3/8	11/32
125	9/16	1/2	1/2	7/16	3/8	3/8
150	5/8	9/16	9/16	1/2	7/16	3/8
175	5/8	5/8	9/16	1/2	1/2	7/16
200	11/16	5/8	5/8	9/16	1/2	7/16

TABLE 1—Continued

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
250	25/32	3/4	11/16	5/8	9/16	1/2
300	13/16	13/16	3/4	11/16	5/8	9/16
350	15/16	7/8	13/16	3/4	11/16	5/8
400	1	15/16	7/8	13/16	3/4	11/16
500	1 1/8	1 1/8	1	15/16	7/8	3/4

TABLE 1A

Authorized gross weight (pounds)	Width of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over :4"	Over 14"
	Minimum thickness of part (in inches)					
15	5/16	5/16	5/16	5/16	5/16	5/16
25	5/16	5/16	5/16	5/16	5/16	5/16
35	5/16	5/16	5/16	5/16	5/16	5/16
45	11/32	11/32	11/32	11/32	11/32	11/32
55	3/8	11/32	11/32	11/32	11/32	11/32
65	3/8	3/8	11/32	11/32	11/32	11/32
75	7/16	3/8	3/8	11/32	11/32	11/32
85	7/16	7/16	3/8	3/8	11/32	11/32
100	1/2	7/16	7/16	3/8	3/8	11/32
125	9/16	1/2	1/2	7/16	3/8	3/8
150	5/8	9/16	9/16	1/2	7/16	3/8
175	5/8	5/8	9/16	1/2	1/2	7/16
200	11/16	5/8	5/8	9/16	1/2	7/16
250	25/32	3/4	11/16	5/8	9/16	1/2
300	13/16	13/16	3/4	11/16	5/8	9/16
350	15/16	7/8	13/16	3/4	11/16	5/8
400	1	15/16	7/8	13/16	3/4	11/16
500	1 1/8	1 1/16	1	15/16	7/8	3/4

TABLE 2

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	11/32	11/32	11/32	11/32	11/32	11/32
35	3/8	11/32	11/32	11/32	11/32	11/32
45	7/16	3/8	3/8	11/32	11/32	11/32
55	1/2	7/16	3/8	3/8	11/32	11/32
65	1/2	1/2	7/16	3/8	3/8	11/32
75	9/16	1/2	1/2	7/16	3/8	3/8
85	9/16	9/16	1/2	7/16	7/16	3/8
100	5/8	9/16	9/16	1/2	7/16	7/16
125	11/16	5/8	5/8	9/16	1/2	7/16
150	3/4	11/16	11/16	5/8	9/16	1/2
175	13/16	3/4	11/16	11/16	5/8	9/16
200	7/8	13/16	3/4	3/4	11/16	5/8
250	1	15/16	7/8	13/16	3/4	5/8
300	1 1/16	1	15/16	7/8	25/32	11/16
350	1 1/8	1 1/16	1	15/16	7/8	3/4
400	1 3/16	1 1/8	1 1/16	1	15/16	13/16
500			1 1/8	1 1/16	1	7/8

TABLE 2A

Authorized gross weight (pounds)	Smallest dimension of end Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	7/16	7/16	7/16	7/16	7/16	7/16
55	1/2	7/16	7/16	7/16	7/16	7/16
65	1/2	1/2	7/16	7/16	7/16	7/16
75	9/16	1/2	1/2	7/16	7/16	7/16
85	9/16	9/16	1/2	7/16	7/16	7/16
100	5/8	9/16	9/16	1/2	7/16	7/16
125	11/16	5/8	5/8	9/16	1/2	7/16
150	3/4	11/16	11/16	5/8	9/16	1/2
175	13/16	3/4	11/16	11/16	5/8	9/16
200	7/8	13/16	3/4	3/4	11/16	5/8
250	1	15/16	7/8	13/16	3/4	5/8
300	1 1/16	1	15/16	7/8	25/32	11/16
350	1 1/8	1 1/16	1	15/16	7/8	3/4
400	1 3/16	1 1/8	1 1/16	1	15/16	13/16
500			1 1/8	1 1/16	1	7/8

TABLE 3

Authorized gross weight (pounds)	Depth of box (inches) Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	5/16	5/16	5/16	5/16	5/16	5/16
25	3/8	11/32	11/32	11/32	11/32	11/32
35	7/16	7/16	3/8	11/32	11/32	11/32
45	1/2	1/2	7/16	7/16	3/8	11/32
55	9/16	1/2	1/2	7/16	7/16	3/8
65	9/16	9/16	9/16	1/2	7/16	7/16
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 5/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 3A

Authorized gross weight (pounds)	Smallest dimension of end Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	1/2	1/2	7/16	7/16	7/16	7/16
55	9/16	1/2	1/2	7/16	7/16	7/16
65	9/16	9/16	9/16	1/2	7/16	7/16

TABLE 3A—Continued

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 5/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 3B

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	7/16	7/16	7/16	7/16	7/16	7/16
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	1/2	1/2	7/16	7/16	7/16	7/16
55	9/16	1/2	1/2	7/16	7/16	7/16
65	9/16	9/16	9/16	1/2	7/16	7/16
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 5/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 4

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	7/16	7/16	7/16	7/16	7/16	7/16
25	7/16	7/16	7/16	7/16	7/16	7/16
35	1/2	1/2	7/16	7/16	7/16	7/16
45	9/16	9/16	1/2	1/2	7/16	7/16
55	5/8	9/16	9/16	1/2	1/2	7/16
65	11/16	5/8	5/8	9/16	1/2	1/2
75	3/4	11/16	5/8	5/8	9/16	1/2
85	25/32	3/4	11/16	5/8	5/8	9/16
100	7/8	13/16	3/4	11/16	5/8	9/16
125	15/16	7/8	13/16	3/4	11/16	5/8
150	1	15/16	15/16	7/8	13/16	11/16

TABLE 5

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	½	½	½	½	½	½
25	½	½	½	½	½	½
35	5/8	9/16	½	½	½	½
45	11/16	5/8	9/16	9/16	½	½
55	¾	11/16	5/8	5/8	9/16	½
65	13/16	¾	11/16	5/8	5/8	9/16
75	7/8	13/16	¾	11/16	5/8	9/16
85	15/16	7/8	13/16	¾	11/16	5/8
100	1	15/16	7/8	13/16	¾	11/16

§ 178.169-13 Reduced thickness.

(a) Reduction in thicknesses is authorized as in paragraphs (a) to (d) of this section except that reduced thicknesses must be not less than:

(1) Sides, top, and bottom: Minimum 5/16" for boxes up to 35 pounds authorized gross weight and 3/8" above that weight.

(2) Ends or cleats: Minimum 7/16".

(b) Sides of one-piece or equivalent: 12½ percent.

(c) Any part or cleat of Group 3 or 4 wood: 20 percent.

(d) Sides, top, and bottom when to be strapped as per § 178.169-19(b): 20 percent for 1 strap; 35 percent for 2 straps.

CONVERSION TABLE

Specified thickness (inches)	Reduced thickness corresponding to percent reduction		
	12½	20	35
9/32	¼	¼	¼
5/16	9/32	¼	¼
11/32	5/16	9/32	¼
3/8	5/16	5/16	¼
7/16	3/8	11/32	9/32
½	7/16	3/8	5/16
9/16	½	7/16	3/8
5/8	9/16	½	7/16
11/16	5/8	9/16	7/16
¾	5/8	5/8	½
25/32	11/16	5/8	½
13/16	11/16	5/8	½
7/8	¾	11/16	9/16
15/16	13/16	¾	5/8
1	7/8	13/16	5/8
1 1/16	15/16	7/8	11/16
1 1/8	1	7/8	¾
1 3/16	1 1/16	15/16	25/32
1 ¼	1 1/8	1	13/16
1 5/16	1 1/8	1 1/16	7/8

§ 178.169-14 Assembly.

(a) By nailing; screws, hinges and hasp, or other device of equal efficiency are authorized; nails should be driven flush.

§ 178.169-15 Nails and nailing.

(a) Cement coated nails of size and with spacing detailed in §§ 178.169-16 and 178.169-17.

(b) At cleated edges drive at least 49 percent of nails into cleats.

(c) Nails fastening cleats to be staggered and clinch 1/8"; uncoated nails authorized.

(d) Nailing tops and bottoms to sides permitted but not required.

§ 178.169-16 Nails; kind and dimensions.

(a) Cement[1] coated of gauge and length as for "sinkers" and "coolers" as generally known to the trade; size [2] in "penny" as follows:

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[1] Uncoated nails authorized when increased 25 percent in number.

[2] Nails 1-penny smaller authorized when spaced as for 2-penny smaller. Nails 2-penny smaller authorized, but not less than 3-penny, when thickness of material nailed through does not exceed ½ of thickness of material holding points of nails.

Species of wood holding points of nails	Thickness of material holding points of nails (inches)										
	3/8 or less	7/16	1/2	9/16	5/8	11/16	3/4	25/32	13/16	7/8	15/16 or more
Group 1	4	5	5	6	7	7	8	8	8	9	10
Group 2	4	4	5	5	6	6	7	7	7	8	9
Group 3	3	4	4	5	5	6	6	7	7	7	8
Group 4	3	3	4	4	4	5	5	6	6	7	7

§ 178.169-17 Nail spacing.[3]

(a) Nail spacing as follows:

Nails (size)	Maximum spacing when driven into end and cleats	
	Side grain	End grains
	Inches	
Threepenny	1¼	1
Fourpenny	1½	1¼
Fivepenny	1¾	1½
Sixpenny	2	1¾
Sevenpenny	2¼	2
Eightpenny	2½	2¼
Ninepenny	2¾	2½
Tenpenny	3	2½

§ 178.169-18 Marking.

(a) Marking on each box with letters and figures at least ½" high in rectangle as follows:

DOT-15B * * *

(1) The stars must be replaced by authorized gross weight (for example, DOT-15B125, etc.).

(b) The words "ONE STRAP", or "TWO STRAPS", etc., when straps are required (see § 178.169-13(d)); this to be placed above or below the rectangle.

(c) Marks may also be applied as follows:

DOT-15B

NO STRAP XXX LBS.

ONE STRAP XXX LBS.

TWO STRAPS XXX LBS.

(1) The "X's" must be replaced by authorized gross weights as authorized for the strapping conditions.

(d) Each box must also be marked with the name or symbol of person making the other marks specified in this section. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.169-19 Closing for shipment.

(a) Box to be securely closed. Nails, if used, to be as prescribed in §§ 178.169-16 and 178.169-17.

(b) Metal straps, as specified by marks on box, must encircle sides, top, and bottom as follows:

(1) One nailless strap: At center of box.

(2) Two or more nailless straps: Outer two about ⅙ of box length from ends and other equally spaced between.

(3) Nailed straps: At ends of sides, top, and bottom; use same size nails as for closing and space not over twice as far apart.

(4) Size of flat straps must be as follows:

---

[3] To determine number of nails, divide length of nailing edge by spacing; fractions greater than ½ are considered as whole numbers.

Authorized gross weight (pounds)	Cross-section size when number of straps is—		
	1	2	3
	Inches		
50	½×0.020	⅜×0.015	
100	⅝×0.020	½×0.018	
200	¾×0.023	⅝×0.020	½×0.018
300		⅝×0.023	½×0.020
400		¾×0.020	½×0.023
500		¾×0.023	⅝×0.023

(5) Wires, Washburn and Moen gauge, authorized as follows:

Authorized gross weight (pounds)	Gauge of wires when number of straps is—		
	1	2	3
50	12	14	
100	11	12	
200	9	11	11
300		10	10
400		10	12
500		9	11

§ 178.170 Specification 15C; wooden boxes, nailed.

§ 178.170–1 Compliance.

(a) Required in all details.

§ 178.170–2 Closed[1] box.

(a) Parts and pieces to be in close contact.

§ 178.170–3 Ends.

(a) One-piece, or equivalent (see § 178.170–4); or cleated as prescribed.

§ 178.170–4 One-piece equivalents.

(a) Parts are considered equivalent to one-piece as follows:

(1) Parts Linderman-joint glued.

(2) Parts at least ½" thick, tongued and grooved and glued, with 2 or more corrugated fasteners on each joint.

(3) Parts at least ½" thick fastened with 3 or more corrugated fasteners on each joint.

(4) Parts butt-joint glued, providing the joined surfaces are planed before gluing, so as to assure full contact. After immersion in water for 24 hours at 70° F. the part must not fail at the joint when it is broken.

(b) Corrugated fasteners (as prescribed for one-piece equivalents); 1" wide; penetration ⅘ thickness of part; within 3" of end of joint and not over 8" apart; for 3 or more, drive alternately into opposite sides of part.

§ 178.170–5 Gluing efficiency.

(a) Shall be determined for boxes for gross weight of 150 pounds or less. When filled with sand and sawdust to marked gross weight, the boxes must be able to withstand 8 drops of 12", one on each corner, onto solid concrete without exposure of contents.

§ 178.170–6 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots that would interfere with nailing, and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within ½ its length.

§ 178.170–7 Nails.

(a) Cement coated, unless otherwise authorized herein, of size specified for "sinkers" and "coolers" as generally known to the trade.

§ 178.170–8 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.
Norway pine.
Aspen (popple).
Spruce.
Western (yellow) pine.
Cottonwood.
Balsam fir.
Yellow poplar.
Chestnut.
Sugar pine.
Cypress.
Basswood.
Willow.
Noble fir.
Magnolia.
Buckeye.
White fir.
Cedar.
Redwood.
Butternut.
Cucumber.
Alpine fir.
Lodgepole pine.
Jack pine.

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[1] Openings for filling device of inside container authorized if device is properly protected.

GROUP 2

Southern yellow pine.
Hemlock.
North Carolina pine.
Douglas fir.
Larch (tamarack)

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black gum.
Black ash.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
Hickory.
White ash.

§ 178.170-9 Width of pieces.

(a) At least 2½".

§ 178.170-10 Width of pieces.

(a) Twice the prescribed thickness plus ¾".

§ 178.170-11 Thickness of lumber.

(a) Nailed boxes not cleated (Style 1): Authorized gross weight not over 100 pounds, see Note 1. Sides as in Table 1; top and bottom as in Table 1A; ends as in Table 5.

(b) Glued-lock-corner boxes (Style 6): Authorized gross weight not over 150 pounds. Sides as in Table 3; top and bottom as in Table 1A; ends as in Table 3A. Or, sides as in Table 2; top and bottom as in Table 1A; ends as in Table 4.

(c) Single-cleated boxes (Style 4 or 5): Authorized gross weight not over 200 pounds, see Note 2. Sides as in Table 1; top and bottom as in Table 1A; ends and cleats as in Table 3A.

(d) Double-cleated boxes (Style 2, 2½, or 3): Authorized gross weight not over 500 pounds, see Note 3. Sides as in Table 1; top and bottom as in Table 1A; end and cleats as in Table 2A. Or, sides as in Table 1; top and bottom as in Table 1A; cleats as in Table 3B; ends not thinner than thickest side or top.

NOTE 1: When group 2 woods are used the gross weight may be increased to 110 pounds.

NOTE 2: When group 2 woods are used the gross weight may be increased to 220 pounds.

NOTE 3: When group 2 woods are used the gross weight may be increased to 550 pounds.

(e) Tables are as follows (dimensions of materials finished or resawed):

TABLE 1

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	¼	¼	¼	¼	¼	¼
25	¼	¼	¼	¼	¼	¼
35	5/16	9/32	9/32	¼	¼	¼
45	11/32	5/16	5/16	9/32	¼	¼
55	⅜	11/32	11/32	5/16	9/32	¼
65	⅜	⅜	11/32	5/16	5/16	9/32
75	7/16	⅜	⅜	11/32	11/32	9/32
85	7/16	7/16	⅜	⅜	11/32	5/16
100	½	7/16	7/16	⅜	⅜	11/32
125	9/16	½	½	7/16	⅜	⅜
150	⅝	9/16	9/16	½	7/16	⅜
175	⅝	⅝	9/16	½	½	7/16
200	11/16	⅝	⅝	9/16	½	7/16
250	25/32	¾	11/16	⅝	9/16	½
300	13/16	13/16	¾	11/16	⅝	9/16
350	15/16	⅞	13/16	¾	11/16	⅝
400	1	15/16	⅞	13/16	¾	11/16
500	1⅛	1 1/16	1	15/16	⅞	¾

TABLE 1A

Authorized gross weight (pounds)	Width of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	1/4	1/4	1/4	1/4	1/4	1/4
25	1/4	1/4	1/4	1/4	1/4	1/4
35	5/16	9/32	9/32	1/4	1/4	1/4
45	11/32	5/16	5/16	9/32	1/4	1/4
55	3/8	11/32	11/32	5/16	9/32	1/4
65	3/8	3/8	11/32	5/16	5/16	9/32
75	7/16	3/8	3/8	11/32	11/32	9/32
85	7/16	7/16	3/8	3/8	11/32	5/16
100	1/2	7/16	7/16	3/8	3/8	11/32
125	9/16	1/2	1/2	7/16	3/8	3/8
150	5/8	9/16	9/16	1/2	7/16	3/8
175	5/8	5/8	9/16	1/2	1/2	7/16
200	11/16	5/8	5/8	9/16	1/2	7/16
250	25/32	3/4	11/16	5/8	9/16	1/2
300	13/16	13/16	3/4	11/16	5/8	9/16
350	15/16	7/8	13/16	3/4	11/16	5/8
400	1	15/16	7/8	13/16	3/4	11/16
500	1 1/8	1 1/16	1	15/16	7/8	3/4

TABLE 2

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	11/32	11/32	5/16	9/32	1/4	1/4
25	11/32	11/32	5/16	9/32	1/4	1/4
35	3/8	11/32	5/16	5/16	9/32	1/4
45	7/16	3/8	3/8	11/32	5/16	9/32
55	1/2	7/16	3/8	3/8	11/32	5/16
65	1/2	1/2	7/16	3/8	3/8	11/32
75	9/16	1/2	1/2	7/16	3/8	3/8
85	9/16	9/16	1/2	7/16	7/16	3/8
100	5/8	9/16	9/16	1/2	7/16	7/16
125	11/16	5/8	5/8	9/16	1/2	7/16
150	3/4	11/16	11/16	5/8	9/16	1/2
175	13/16	3/4	11/16	11/16	5/8	9/16
200	7/8	13/16	3/4	3/4	11/16	5/8
250	1	15/16	7/8	13/16	3/4	5/8
300	1 1/16	1	15/16	7/8	25/32	11/16
350	1 1/8	1 1/16	1	15/16	7/8	3/4
400	1 3/16	1 1/8	1 1/16	1	15/16	13/16
500	....	....	1 1/8	1 1/16	1	7/8

TABLE 2A

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	7/16	7/16	7/16	7/16	7/16	7/16
55	1/2	7/16	7/16	7/16	7/16	7/16
65	1/2	1/2	7/16	7/16	7/16	7/16

TABLE 2A—Continued

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
75	9/16	1/2	1/2	7/16	7/16	7/16
85	9/16	9/16	1/2	7/16	7/16	7/16
100	5/8	9/16	9/16	1/2	7/16	7/16
125	11/16	5/8	5/8	9/16	1/2	7/16
150	3/4	11/16	11/16	5/8	9/16	1/2
175	13/16	3/4	11/16	11/16	5/8	9/16
200	7/8	13/16	3/4	3/4	11/16	5/8
250	1	15/16	7/8	13/16	3/4	5/8
300	1 1/16	1	15/16	7/8	25/32	11/16
350	1 1/8	1 1/16	1	15/16	7/8	3/4
400	1 3/16	1 1/8	1 1/16	1	15/16	13/16
500			1 1/8	1 1/16	1	7/8

TABLE 3

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	9/32	9/32	1/4	1/4	1/4	1/4
25	3/8	11/32	11/32	5/16	9/32	1/4
35	7/16	7/16	3/8	11/32	11/32	9/32
45	1/2	1/2	7/16	7/16	3/8	11/32
55	9/16	1/2	1/2	7/16	7/16	3/8
65	9/16	9/16	9/16	1/2	7/16	7/16
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 3/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 3A

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	1/2	1/2	7/16	7/16	7/16	7/16
55	9/16	1/2	1/2	7/16	7/16	7/16
65	9/16	9/16	9/16	1/2	7/16	7/16
75	5/8	5/8	9/16	1/2	1/2	7/16
85	1 1/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32

TABLE 3A—Continued

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
300	1 5/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 3B

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	7/16	7/16	7/16	7/16	7/16	7/16
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	1/2	1/2	7/16	7/16	7/16	7/16
55	9/16	1/2	1/2	7/16	7/16	7/16
65	9/16	9/16	9/16	1/2	7/16	7/16
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 5/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		15/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 4

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	7/16	7/16	7/16	7/16	7/16	7/16
25	7/16	7/16	7/16	7/16	7/16	7/16
35	1/2	1/2	7/16	7/16	7/16	7/16
45	9/16	9/16	1/2	1/2	7/16	7/16
55	5/8	9/16	9/16	1/2	1/2	7/16
65	11/16	5/8	5/8	9/16	1/2	1/2
75	3/4	11/16	5/8	5/8	9/16	1/2
85	25/32	3/4	11/16	5/8	5/8	9/16
100	7/8	13/16	3/4	11/16	5/8	9/16
125	15/16	7/8	13/16	3/4	11/16	5/8
150	1	15/16	15/16	7/8	3/16	11/16

TABLE 5

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	½	½	½	½	½	½
25	½	½	½	½	½	½
35	⅝	9/16	½	½	½	½
45	11/16	⅝	9/16	9/16	½	½
55	¾	11/16	⅝	⅝	9/16	½
65	13/16	¾	11/16	⅝	⅝	9/16
75	⅞	13/16	¾	11/16	⅝	9/16
85	15/16	⅞	13/16	¾	11/16	⅝
100	1	15/16	⅞	13/16	¾	11/16

§ 178.170–12 Reduced thicknesses.

(a) Reduction in thicknesses is authorized as in paragraphs (a) to (d) of this section except that reduced thicknesses must be not less than:

(1) Sides, top, and bottom: Minimum ¼" for boxes up to 150 pounds authorized gross weight and ⅜" above that weight.

(2) Ends or cleats: Minimum 7/16".

(b) Sides of one-piece or equivalent: 12½ percent.

(c) Any part or cleat of Group 3 or 4 wood: 20 percent.

(d) Sides, top, and bottom when to be strapped as per § 178.170–18(b): 20 percent for 1 strap; 35 percent for 2 straps.

CONVERSION TABLE

Specified thickness (inches)	Reduced thickness corresponding to percent reduction		
	12½	20	35
9/32	¼	¼	¼
5/16	9/32	¼	¼
11/32	5/16	9/32	¼
⅜	5/16	5/16	¼
7/16	⅜	11/32	9/32
½	7/16	⅜	5/16
9/16	½	7/16	⅜
⅝	9/16	½	7/16
11/16	⅝	9/16	7/16
¾	⅝	⅝	½
25/32	11/16	⅝	½
13/16	11/16	⅝	½
⅞	¾	11/16	9/16
15/16	13/16	¾	⅝
1	⅞	13/16	⅝
1 1/16	15/16	⅞	11/16
1 ⅛	1	⅞	¾
1 3/16	1 1/16	15/16	25/32
1 ¼	1 ⅛	1	13/16
1 5/16	1 ⅛	1 1/16	⅞

§ 178.170–13 Assembly.

(a) By nailing; screws, hinges and hasp, or other device of equal efficiency are authorized; nails should be driven flush.

§ 178.170–14 Nails and nailing.

(a) Cement coated nails of size and with spacing detailed in §§ 178.170–15 and 178.170–16.

(b) At cleated edges drive at least 40 percent of nails into cleats.

(c) Nails fastening cleats to be staggered and clinch ⅛"; uncoated nails authorized.

(d) Nailing tops and bottoms to sides permitted but not required.

§ 178.170–15 Nails; kind and dimensions.

(a) Cement[1] coated of gauge and length as for "sinkers" and "coolers" as generally known to the trade; size [2] in "penny" as follows:

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[1] Uncoated nails authorized when increased 25 percent in number.

[2] Nails 1-penny smaller authorized when spaced as for 2-penny smaller. Nails 2-penny smaller authorized, but not less than 3-penny, when thickness of material nailed through does not exceed ½ of thickness of material holding points of nails.

Species of wood holding points of nails	Thickness of material holding points of nails (inches)										
	⅜ or less	7/16	½	9/16	⅝	11/16	¾	25/32	13/16	⅞	15/16 or more
Group 1	4	5	5	6	7	7	8	8	8	9	10
Group 2	4	4	5	5	6	6	7	7	7	8	9
Group 3	3	4	4	5	5	6	6	7	7	7	8
Group 4	3	3	4	4	4	5	5	6	6	7	7

§ 178.170-16 Nail spacing.[3]

(a) Nail spacing as follows:

Nails (size)	Maximum spacing when driven in [illegible] and cleats	
	Side grain	End grains
	Inches	
Threepenny	1¼	1
Fourpenny	1½	1¼
Fivepenny	1¾	1½
Sixpenny	2	1¾
Sevenpenny	2¼	2
Eightpenny	2½	2¼
Ninepenny	2¾	2½
Tenpenny	3	2½

§ 178.170-17 Marking.

(a) Marking on each box with letters and figures at least ½" high in rectangle as follows:

DOT-15C * * *

(1) The stars must be replaced by authorized gross weight (for example, DOT-15C100, etc.).

(b) The words "ONE STRAP", or "TWO STRAPS", etc., when straps are required (see § 178.170-12(d)); this to be placed above or below the rectangle.

(c) Marks may also be applied as follows:

DOT-15C

NO STRAP XXX LBS.

ONE STRAP XXX LBS.

TWO STRAPS XXX LBS.

(1) The "X's" must be replaced by authorized gross weights as authorized for the strapping conditions.

(d) Each box must also be marked with the name or symbol of person making the other marks specified in this section. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.170-18 Closing for shipment.

(a) Box to be securely closed. Nails, if used, to be as prescribed in §§ 178.170-15 and 178.170-16.

(b) Metal straps, as specified by marks on box, must encircle sides, top, and bottom as follows:

(1) One nailless strap: At center of box.

(2) Two or more nailless straps: Outer two about ⅛ of box length from ends and other equally spaced between.

(3) Nailed straps: At ends of sides, top, and bottom; use same size nails as for closing and space not over twice as far apart.

(4) Size of flat straps must be as follows:

Authorized gross weight (pounds)	Cross-section size when number of straps is—		
	1	2	3
	Inches		
50	½×0.020	⅜×0.015	
100	⅝×0.020	½×0.018	
200	¾×0.023	⅝×0.020	½×0.018
300		⅝×0.023	½×0.020
400		¾×0.020	½×0.023
500		¾×0.023	⅝×0.023

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[3] To determine number of nails, divide length of nailing edge by spacing; fractions greater than ½ are considered as whole numbers.

(5) Wires, Washburn and Moen gauge, authorized as follows:

Authorized gross weight (pounds)	Gauge of wires when number of straps is—		
	1	2	3
50	12	14	....
100	11	12	....
200	9	11	12
300	....	10	11
400	....	10	11
500	....	9	10

§ 178.171 Specification 15D; wooden boxes, nailed.

§ 178.171-1 Compliance.

(a) Required in all details.

§ 178.171-2 Space between boards.

(a) Space 4" wide authorized except that bottom pieces must be in close contact with each other and with sides and ends.

§ 178.171-3 Ends.

(a) One-piece, or equivalent (see § 178.171-5); or cleated as prescribed.

§ 178.171-4 Handles.

(a) Containers may be provided with suitable handles at discretion of shipper. Handles must be of dimensions specified herein, consisting of horizontal strips or cleats extending across top of each side or each end; handles which do not project 3 inches beyond the vertical edges of the container must be mounted to leave at least 7/16 inch open space between handle and box, or be at least ¾ inch thick, or be of cross section at least equal to cleats required for single-cleated boxes of corresponding size and gross weight. Extension of cleats or side boards is acceptable for projecting handles.

Authorized gross weight, maximum (pounds)	Handles, minimum cross section (inches)
100	½×1¾
150	½×2¾
200	⅝×2½
300	⅝×3½
400	13/16×3½

§ 178.171-5 One-piece equivalents.

(a) Parts are considered equivalent to one-piece as follows:

(1) Parts Linderman-joint glued.

(2) Parts at least ½" thick, tongued and grooved and glued, with 2 or more corrugated fasteners on each joint.

(3) Parts at least ½" thick fastened with 3 or more corrugated fasteners on each joint.

(4) Parts butt-joint glued, provided the joined surfaces are planed before gluing, so as to assure full contact. After immersion in water for 24 hours at 70° F. the part must not fail at the joint when it is broken.

(b) Corrugated fasteners (as prescribed for one-piece equivalents). 1" wide; penetration ⅘ thickness of part; within 3" of end of joint and not over 8" apart; for 3 or more, drive alternately into opposite sides of part.

§ 178.171-6 Gluing efficiency.

(a) Shall be determined for boxes for gross weight of 150 pounds or less. When filled with sand and sawdust to marked gross weight, the boxes must be able to withstand 8 drops of 12", one on each corner, onto solid concrete without exposure of contents.

§ 178.171-7 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within ½ its length.

§ 178.171-8 Nails.

(a) Cement coated, unless otherwise authorized herein, of size specified for "sinkers" and "coolers" as generally known to the trade.

§ 178.171-9 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.
Norway pine.
Aspen (popple).
Spruce.
Western (yellow) pine.
Cottonwood.
Balsam fir.
Buckeye.
White fir.
Cedar.
Redwood.
Butternut.
Yellow poplar.
Chestnut.
Sugar pine.
Cypress.
Basswood.
Willow.
Noble fir.
Magnolia.
Cucumber.
Alpine fir.
Lodgepole pine.
Jack pine.

GROUP 2

Southern yellow pine.
Hemlock.
North Carolina pine.
Douglas fir.
Larch (tamarack)

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black gum.
Black ash.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
Hickory.
White ash.

§ 178.171-10 Width of pieces.

(a) At least 2½".

§ 178.171-11 Width of cleats.

(a) Twice the prescribed thickness plus ¾".

§ 178.171-12 Thickness of lumber.

(a) Nailed boxes not cleated (Style 1): Authorized gross weight not over 100 pounds, see Note 1. Sides as in Table 1; top and bottom as in Table 1A; ends as in Table 5.

(b) Glued-lock-corner boxes (Style 6): Authorized gross weight not over 150 pounds. Sides as in Table 3; top and bottom as in Table 1A; ends as in Table 3A. Or, sides as in Table 2; top and bottom as in Table 1A; ends as in Table 4.

(c) Single-cleated boxes (Style 4 or 5): Authorized gross weight not over 200 pounds for boxes with vertical cleats nor over 400 pounds for boxes with horizontal cleats. Sides as in Table 1; top and bottom as in Table 1A; ends and cleats as in Table 3A.

(d) Double-cleated boxes (Style 2, 2½, or 3): Authorized gross weight not over 500 pounds. Sides as in Table 1; top and bottom as in Table 1A; ends and cleats as in Table 2A. Or, sides as in Table 1; top and bottom as in Table 1A, cleats as in Table 3B; ends not thinner than thinnest side or top.

Exception: For containers consisting of an inner wooden crate of at least ⅜" thickness throughout, with or without top, and an outside double cleated box without the openings permitted by § 178.171-2, the thickness of all parts of the outside box may be reduced to not less than ¾".

(e) Tables are as follows (dimensions of materials finished or resawed):

TABLE 1

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	5/16	5/16	5/16	5/16	5/16	5/16
25	5/16	5/16	5/16	5/16	5/16	5/16
35	5/16	5/16	5/16	5/16	5/16	5/16

TABLE 1—Continued

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
45	11/32	11/32	11/32	11/32	11/32	11/32
55	3/8	11/32	11/32	11/32	11/32	11/32
65	3/8	3/8	11/32	11/32	11/32	11/32
75	7/16	3/8	3/8	11/32	11/32	11/32
85	7/16	7/16	3/8	3/8	11/32	11/32
100	1/2	7/16	7/16	3/8	3/8	11/32
125	9/16	1/2	1/2	7/16	3/8	3/8
150	5/8	9/16	9/16	1/2	7/16	3/8
175	5/8	5/8	9/16	1/2	1/2	7/16
200	11/16	5/8	5/8	9/16	1/2	7/16
250	25/32	3/4	11/16	5/8	9/16	1/2
300	13/16	13/16	3/4	11/16	5/8	9/16
350	15/16	7/8	13/16	3/4	1 1/16	5/8
400	1	15/16	7/8	13/16	3/4	11/16
500	1 1/8	11/16	1	15/16	7/8	3/4

TABLE 1A

Authorized gross weight (pounds)	Width of box (inches)					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	5/16	5/16	5/16	5/16	5/16	5/16
25	5/16	5/16	5/16	5/16	5/16	5/16
35	5/16	5/16	5/16	5/16	5/16	5/16
45	11/32	11/32	11/32	11/32	11/32	11/32
55	3/8	11/32	11/32	11/32	11/32	11/32
65	3/8	3/8	11/32	11/32	11/32	11/32
75	7/16	3/8	3/8	11/32	11/32	11/32
85	7/16	7/16	3/8	3/8	11/32	11/32
100	1/2	7/16	7/16	3/8	3/8	11/32
125	9/16	1/2	1/2	7/16	3/8	3/8
150	5/8	9/16	9/16	1/2	7/16	3/8
175	5/8	5/8	9/16	1/2	1/2	7/16
200	11/16	5/8	5/8	9/16	1/2	7/16
250	25/32	3/4	11/16	5/8	9/16	1/2
300	13/16	13/16	3/4	11/16	5/8	9/16
350	15/16	7/8	13/16	3/4	11/16	5/8
400	1	15/16	7/8	13/16	3/4	11/16
500	1 1/8	1 1/16	1	15/16	7/8	3/4

TABLE 2

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	11/32	11/32	11/32	11/32	11/32	11/32
35	3/8	11/32	11/32	11/32	11/32	11/32
45	7/16	3/8	3/8	11/32	11/32	11/32
55	1/2	7/16	3/8	3/8	11/32	11/32
65	1/2	1/2	7/16	3/8	3/8	11/32
75	9/16	1/2	1/2	7/16	3/8	3/8
85	9/16	9/16	1/2	7/16	7/16	3/8
100	5/8	9/16	9/16	1/2	7/16	7/16
125	11/16	5/8	5/8	9/16	1/2	7/16
150	3/4	11/16	11/16	5/8	9/16	1/2

TABLE 2—Continued

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
175	13/16	3/4	11/16	11/16	5/8	9/16
200	7/8	13/16	3/4	3/4	11/16	5/8
250	1	15/16	7/8	13/16	3/4	5/8
300	1 1/16	1	15/16	7/8	25/32	11/16
350	1 1/8	1 1/16	1	15/16	7/8	3/4
400	1 3/16	1 1/8	1 1/16	1	15/16	13/16
500			1 1/8	1 1/16	1	7/8

TABLE 2A

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	7/16	7/16	7/16	7/16	7/16	7/16
55	1/2	7/16	7/16	7/16	7/16	7/16
65	1/2	1/2	7/16	7/16	7/16	7/16
75	9/16	1/2	1/2	7/16	7/16	7/16
85	9/16	9/16	1/2	7/16	7/16	7/16
100	5/8	9/16	9/16	1/2	7/16	7/16
125	11/16	5/8	5/8	9/16	1/2	7/16
150	3/4	11/16	11/16	5/8	9/16	1/2
175	13/16	3/4	11/16	11/16	5/8	9/16
200	7/8	13/16	3/4	3/4	11/16	5/8
250	1	15/16	7/8	13/16	3/4	5/8
300	11/16	1	15/16	7/8	25/32	11/16
350	1 1/8	11/16	1	15/16	7/8	3/4
400	13/16	1 1/8	11/16	1	15/16	13/16
500			1 1/8	11/16	1	7/8

TABLE 3

Authorized gross weight (pounds)	Depth of box (inches)					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	5/16	5/16	5/16	5/16	5/16	5/16
25	3/8	11/32	11/32	11/32	11/32	11/32
35	7/16	7/16	3/8	11/32	11/32	11/32
45	1/2	1/2	7/16	7/16	3/8	11/32
55	9/16	1/2	1/2	7/16	7/16	3/8
65	9/16	9/16	9/16	1/2	7/16	7/16
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 5/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 3A

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	11/32	11/32	11/32	11/32	11/32	11/32
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	1/2	1/2	7/16	7/16	7/16	7/16
55	9/16	1/2	1/2	7/16	7/16	7/16
65	9/16	9/16	9/16	1/2	7/16	7/16
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	1/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 5/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 3B

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	7/16	7/16	7/16	7/16	7/16	7/16
25	7/16	7/16	7/16	7/16	7/16	7/16
35	7/16	7/16	7/16	7/16	7/16	7/16
45	1/2	1/2	7/16	7/16	7/16	7/16
55	9/16	1/2	1/2	7/16	7/16	7/16
65	9/16	9/16	9/16	1/2	7/16	7/16
75	5/8	5/8	9/16	1/2	1/2	7/16
85	11/16	11/16	5/8	9/16	1/2	1/2
100	3/4	11/16	11/16	5/8	9/16	1/2
125	13/16	3/4	3/4	11/16	5/8	9/16
150	15/16	7/8	13/16	3/4	11/16	5/8
175	1	15/16	7/8	13/16	3/4	11/16
200	1 1/16	1	15/16	7/8	25/32	11/16
250	1 1/8	1 1/16	1	15/16	7/8	25/32
300	1 5/16	1 3/16	1 1/8	1 1/16	15/16	7/8
350		1 5/16	1 1/4	1 1/8	1	15/16
400				1 1/4	1 1/8	1
500					1 1/4	1 1/8

TABLE 4

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8″	Not over 9″	Not over 10″	Not over 12″	Not over 14″	Over 14″
	Minimum thickness of part (in inches)					
15	7/16	7/16	7/16	7/16	7/16	7/16
25	7/16	7/16	7/16	7/16	7/16	7/16
35	1/2	1/2	7/16	7/16	7/16	7/16
45	9/16	9/16	1/2	1/2	7/16	7/16
55	5/8	9/16	9/16	1/2	1/2	7/16
65	11/16	5/8	5/8	9/16	1/2	1/2

TABLE 4—Continued

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
75	3/4	11/16	5/8	5/8	9/16	1/2
85	25/32	3/4	11/16	5/8	5/8	9/16
100	7/8	13/16	3/4	11/16	5/8	9/16
125	15/16	7/8	13/16	3/4	11/16	5/8
150	1	15/16	15/16	7/8	13/16	11/16

TABLE 5

Authorized gross weight (pounds)	Smallest dimension of end					
	Not over 8"	Not over 9"	Not over 10"	Not over 12"	Not over 14"	Over 14"
	Minimum thickness of part (in inches)					
15	1/2	1/2	1/2	1/2	1/2	1/2
25	1/2	1/2	1/2	1/2	1/2	1/2
35	5/8	9/16	1/2	1/2	1/2	1/2
45	11/16	5/8	9/16	9/16	1/2	1/2
55	3/4	11/16	5/8	5/8	9/16	1/2
65	13/16	3/4	11/16	5/8	5/8	9/16
75	7/8	1 3/16	3/4	11/16	5/8	9/16
85	15/16	7/8	13/16	3/4	11/16	5/8
100	1	15/16	7/8	13/16	3/4	11/16

§ 178.171-13 Reduced thicknesses.

(a) Reduction in thicknesses is authorized as in paragraphs (a) to (d) of this section except that reduced thicknesses must be not less than:

(1) Sides, top, and bottom: Minimum 5/16" for boxes up to 35 pounds authorized gross weight and 3/8" above that weight.

(2) Ends or cleats: Minimum 7/16".

(b) Sides of one-piece or equivalent: 12½ percent. In battery boxes reinforced with separate pieces in the form of extension handles, not extension of side boards or cleats, having cross section at least equal to cleats required for single-cleated boxes of corresponding size and gross weight, 20 percent in sides of ends so reinforced.

(c) Any part or cleat of Group 3 or 4 wood: 20 percent.

(d) Sides, top, and bottom when to be strapped as per § 178.171-18(b): 20 percent for 1 strap; 35 percent for 2 straps.

CONVERSION TABLE

Specified thickness (inches)	Reduced thickness corresponding to percent reduction		
	12½	20	35
9/32	1/4	1/4	1/6
5/16	9/32	1/4	1/4
11/32	5/16	9/32	1/4
3/8	5/16	5/16	1/4
7/16	3/8	11/32	9/32
1/2	7/16	3/8	5/16
9/16	1/2	7/16	3/8
5/8	9/16	1/2	7/16
11/16	5/8	9/16	7/16
3/4	5/8	5/8	1/2
25/32	11/16	5/8	1/2
13/16	11/16	5/8	1/2
7/8	3/4	11/16	9/16
15/16	13/16	3/4	5/8
1	7/8	13/16	5/8
1 1/16	15/16	7/8	11/16
1 1/8	1	7/8	3/4
1 3/16	1 1/16	15/16	25/32
1 1/4	1 1/8	1	1 3/16
1 5/16	1 1/8	1 1/16	7/8

§ 178.171-14 Nails and nailing.

(a) Cement coated nails of size and with spacing detailed in §§ 178.171-15 and 178.171-16.

(b) At cleated edges drive at least 40 percent of nails into cleats.

(c) Nails fastening cleats to be staggered and clinch ⅛"; uncoated nails authorized.

(d) Nailing tops and bottoms to sides permitted but not required.

§ 178.171-15 Nails; kind of dimensions.

(a) Cement[1] coated of gauge and length as for "sinkers" and "coolers" as generally known to the trade; size[2] in "penny" as follows:

Species of wood holding points of nails	Thickness of material holding points of nails (inches)										
	⅜ or less	7/16	½	9/16	⅝	11/16	¾	25/32	13/16	⅞	15/16 or more
Group 1	4	5	5	6	7	7	8	8	8	9	10
Group 2	4	4	5	5	6	6	7	7	7	8	9
Group 3	3	4	4	5	5	6	6	7	7	7	8
Group 4	3	3	4	4	4	5	5	6	6	7	7

§ 178.171-16 Nail spacing.[3]

(a) Nail spacing as follows:

Nails (size)	Maximum spacing when driven into end and cleats	
	Side grain	End grains
	Inches	
Threepenny	1¼	1
Fourpenny	1½	1¼
Fivepenny	1¾	1½
Sixpenny	2	1¾
Sevenpenny	2¼	2
Eightpenny	2½	2¼
Ninepenny	2¾	2½
Tenpenny	3	2½

§ 178.171-17 Marking.

(a) Marking on each box with letters and figures at least ½" high in rectangle as follows:

DOT-15E * * *

(1) The stars must be replaced by authorized gross weight (for example, DOT-15D125, etc.).

(b) The words "ONE STRAP", or "TWO STRAPS", etc., when straps are required (see § 178.171-13(d)); this to be placed above or below the rectangle.

(c) Marks may also be applied as follows:

DOT-15D

NO STRAP XXX LBS.

ONE STRAP XXX LBS.

TWO STRAPS XXX LBS.

(1) The "X's" must be replaced by authorized gross weights as authorized for the strapping conditions.

(d) Each box must also be marked with the name or symbol of person making the other marks specified in this section. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.171-18 Closing for shipment.

(a) Box to be securely closed. Nails, if used, to be as prescribed in §§ 178.171-15 and 178.171-16.

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[1] Uncoated nails authorized when increased 25 percent in number.

[2] Nails 1-penny smaller authorized when spaced as for 2-penny smaller. Nails 2-penny smaller authorized, but not less than 3-penny, when thickness of material nailed through does not exceed ½ of thickness of material holding points of nails.

[3] To determine number of nails, divide length of nailing edge by spacing; fractions greater than ½ are considered as whole numbers.

(b) Metal straps, as specified by marks on box, must encircle sides, top, and bottom as follows:

(1) One nailless strap: At center of box.

(2) Two or more nailless straps: Outer two about ⅛ of box length from ends and other equally spaced between.

(3) Nailed straps: At ends of sides, top and bottom, use same size nails as for closing and space not over twice as far apart.

(4) Size of flat straps must be as follows:

Authorized gross weight (pounds)	Cross-section size when number of straps is—		
	1	2	3
		Inches	
50	½ x 0.020	⅜ x 0.015	
100	⅝ x 0.020	½ x 0.018	
200	¾ x 0.023	⅝ x 0.020	½ x 0.018
300		⅝ x 0,023	½ x 0.020
400		¾ x 0.020	½ x 0.023
500		¾ x 0.023	⅝ x 0.023

(5) Wires, Washburn and Moen gauge, authorized as follows:

Authorized gross weight (pounds)	Gauge of wires when number of straps is—		
	1	2	3
50	12	14	
100	11	12	
200	9	11	12
300		10	11
400		10	11
500		9	10

§ 178.171-19 Boxes for shipment of wet electric storage batteries.

(a) Boxes over 500 pounds gross weight are authorized for shipments of wet electric storage batteries when the batteries are contained in a rigid cradle or box, or are securely fastened together so as to form a single unit, and not more than one such cradle box, or unit is packed in the outside container. Skids required: Runners to be at least 2 inches by 4 inches commercial thickness, minimum of three, except that two runners are authorized when width of case does not exceed 24 inches; or two runners may be used, minimum of 4 inches by 4 inches commercial thickness, when case does not exceed 36 inches in width. Runners to be beveled at ends to facilitate use of rollers. Bottom boards, minimum of 1 inch commercial thickness, to be nailed across runners; bracing of parts and thickness of lumber to be sufficient to protect contents in transit.

§ 178.172 Specification 15E; wooden boxes, fiberboard lined.

§ 178.172-1 Compliance.

(a) Required in all details.

§ 178.172-2 Closed box.

(a) Parts and pieces to be in close contact.

§ 178.172-3 Ends.

(a) Butt-joint glued to fiberboard plywood not authorized.

§ 178.172-4 Sides, top, and bottom.

(a) Butt-joint or plywood glued to fiberboard.

§ 178.172-5 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength. Grain of wood in cleats must not cross cleat within ½ its length.

(b) Plywood, if used, shall be free of knots, decay, and other visible defects that interfere with the nailing. Plywood used must be of good commercial box or sheathing grade veneer.

§ 178.172-6 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.
Norway pine.
Aspen (popple).
Spruce.
Western (yellow) pine.
Cottonwood.
Noble fir.
Magnolia.
Buckeye.
White fir.
Cedar.
Redwood.
Balsam fir.
Yellow poplar.

Chestnut.
Sugar pine.
Cypress.
Basswood.
Willow.
Butternut.
Cucumber.
Alpine fir.
Lodgepole pine.
Jack pine.

GROUP 2

Southern yellow pine.
Hemlock.
North Carolina pine.
Douglas fir.
Larch (tamarack).

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black gum.
Black ash.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Birch.
Rock elm.
Oak.
Hackberry.
Hickory.
White ash.

§ 178.172-7 Width of pieces.

(a) At least 2½ inches.

§ 178.172-8 Thickness of wood parts.

(a) Thickness as follows:

Authorized gross weight of box not over (pounds)	Style of box (see Notes 2 and 3)	Minimum thickness (see Note 1) of sides, top and bottom in inches		Thickness of ends and cleats in inches		Minimum width of cleats in inches	Size of nails in end (penny)	
		Groups 1 and 2	Groups 3 and 4	Groups 1 and 2	Groups 3 and 4		Groups 1 and 2	Groups 3 and 4
150	1, 2, 2½, 3 or 4	3/16	1/8	½	½	1¾	4	4
250	2½, 3 or 4	7/32	3/16	5/8	9/16	1⅞	5	4
350	2½ or 3	¼	7/32	¾	11/16	2¼	6	5
450	2½ or 3	5/16	¼	25/32	25/32	2¼	6	5
550	2½ or 3	3/8	5/16	13/16	13/16	2½	7	6

NOTE 1: Plywood or paper covered wood veneer board of equal thickness and efficiency is permitted. Paper covered veneer board shall be of good quality Douglas fir core of at least 3/16 inch thickness, or lumber of equal quality, and free of breaks, gaps, holes, or knots. Paper covering shall be at least Kraft untreated linerboard having a basis weight of 42 pounds per 1,000 square feet and shall be secured to veneer core by adhesive in such manner as to form a satisfactorily laminated board.

NOTE 2: Thickness of ends in style 1 boxes shall be not less than 25/32 inch and load limit shall be not more than 100 pounds.

NOTE 3: Style 4 boxes have load limit of 200 pounds.

§ 178.172-9 Assembly.

(a) By nails, screws, staples or other devices of equal efficiency. Nails, screws and staples must be driven flush.

§ 178.172-10 Nails and nailing.

(a) Cement coated nails of size and with spacing detailed in §§ 178.172-8 178.172-11 and 178.172-12.

(b) At cleated edges drive at least 40 percent of nails into cleats.

(c) Nails fastening cleats to ends be staggered and clinch ⅛ inch; uncoated nails authorized.

§ 178.172-11 Nails; kind and dimensions.

(a) Cement[1] coated of gauge and length as for "sinkers" and "coolers" as generally known to the trade; size in penny as prescribed in § 178.172-8.

§ 178.172-12 Nail spacing.[2]

(a) Nail spacing as follows:

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[1] Uncoated nails authorized when increased 25 percent in number.

[2] To determine number of nails, divide length of nailing edge by spacing; fractions greater than ½ are considered as whole

Continued

Nails (size)	Maximum spacing when driven into end and cleats	
	Side grain	End grains
	Inches	
Fourpenny	1½	1¼
Fivepenny	1¾	1½
Sixpenny	2	1¾
Sevenpenny	2¼	2

§ 178.172-13 Classification of board.

(a) Fiberboard is hereby classified by strength[3] of completed board as in first column of the following table; weights specified in the table are the minimum authorized:

Authorized gross weight of box not over (pounds)	Classified strength[1] of completed board	Solid fiberboard minimum combined weight of component plies exclusive of adhesives (pounds per 1,000 sq. ft.)	Facings of corrugated fiberboard double-faced minimum combined weight of facings (pounds per 1,000 sq. ft.)
150	200	190	84
250	275	237	138
350	325	237	138
450	350	283	180
550	375	283	180

[1] Mullen or Cady test (minimum).

§ 178.172-14 Solid fiberboard.

(a) To be 3-ply or more; both outer plies water resistant.

§ 178.172-15 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1,000 square feet; all parts must be securely glued together throughout all contact areas.

§ 178.172-16 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(4) For corrugated fiberboard, double-pop tests may be disregarded.

§ 178.172-17 Assembly.

(a) The sheet of fiberboard to which are glued the boards forming the sides top and bottom box sections, shall be properly scored to form a tube. The joint shall be on a side, top or bottom near the center of the face, and located under one of the wood boards of the face.

(1) A water resistant glue shall be used to attach the fiberboard to the wood. The glue shall be applied in ribbons (lines) at right angles to the scores of the tube. The ribbons of glue shall be not less than 1¼" wide and shall be spaced sufficiently close so that glue will cover not less than 25 percent of the surface of the fiberboard. The ribbons of glue shall be equally spaced on the length of the box with the outside ribbons flush with the ends of the tube. Glue shall be applied to the fiberboard on the ends of the box in like amount as on the tube.

(2) For styles 2, 2½, and 3, all faces of the tube shall extend over the end boards and cleats. For style 4, all faces shall extend over the end boards, but only the side sections shall extend over the cleats.

(3) The boards between score lines shall butt against each other when placed on the fiberboard, and the combined widths of the boards shall be approximately equal to the inside dimension of the respective box section so that the boards completely cover the fiberboard between the inside edges of adjacent scores.

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numbers. Each piece of sides, top and bottom shall be nailed to the ends with at least two nails through each end of the piece.

[3] Mullen or Cady test (minimum).

(4) A sheet of fiberboard shall be attached to each end as provided in paragraph (a)(1) of this section and shall completely cover the inside of the end.

§ 178.172-18 Closing for shipment.

(a) Box shall be securely closed. Nails, if used, shall be as prescribed in §§ 178.172-9, 178.172-10, 178.172-11, and 178.172-12.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-63, 45 FR 62083, Sept. 18, 1980]

§ 178.172-19 Marking.

(a) Marking on each box with letters and figures at least ½" high in rectangle as follows:

DOT-15E * * *

(1) The stars must be replaced by authorized gross weight (for example, DOT-15E100, etc.).

(b) Each box must also be marked with the name or symbol of person making the mark specified in paragraph (a) of this section. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.176 Specification 15L; wooden boxes with inside containers for desensitized liquid explosives.

§ 178.176-1 Compliance.

(a) Required in all details.

§ 178.176-2 Size and capacity.

(a) Each outside wooden container shall contain not more than one inside metal container having a capacity not to exceed 10 quarts.

§ 178.176-3 Outside containers.

(a) Wooden boxes cleated as prescribed. Parts must be in close contact and completely enclose inside containers. Lumber must be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with assembly, or other defects that materially lessen the strength.

(b) Assembly: Use brass screws throughout. Assemble sides and ends with grain of wood vertical. Fasten bottom securely with edges flush with sides and ends of box. Cleats must extend around entire perimeter of box. Apply top and bottom cleats horizontally. Bottom cleats must be flush with bottom surface of the box. Top cleats must extend above top of box to provide a ¾-inch recess for cover projections (see § 178.176-5). Cover must be flush with outside surface of top cleats and must be cleated on the outside at all edges. Cleats may be mitered but must butt at all corners.

(c) Parts and dimensions as follows:

[Minimum dimensions in inches]

Thickness, sides, top, bottom, and end	Top cleats	Bottom cleats	Clover cleats
¾	¾ × 3½	¾ × 2¾	¾ × 2

§ 178.176-4 Inside containers.

(a) Inside containers must be as follows:

(1) *Metal containers.* Double se[illegible] of copper weighing not less [illegible] ounces per square foot, or ot[illegible] sparking material of e[illegible] strength. All seams must be [illegible] welding, brazing, or soldering [illegible] be tight against leakage. Handles must be fastened to top of container and be of copper weighing not less than 48 ounces per square foot, or other nonsparking material of equivalent strength. Each side of the container must be strengthened vertically by at least three equally spaced indented crimps. Each container must have two pouring spouts in the top securely closed by rubber stoppers.

(2) *Rubber liners.* Each inside metal container must be inserted in a two-piece rubber liner or boot, consisting of a cover and body, into which it must fit snugly and which in turn shall fit snugly the outside wooden container. This liner must be watertight and of such size as to fully protect the inside container. Sides of liner must be at least ¼ inch in thickness and bottom at least ½ inch in thick-

ness. Top edge of boot must be flanged to fit the recess provided by the top cleats on the outside wooden container and such flange must be at least ⅜ inch thick exclusive of any channels or indentations necessary to effect satisfactory closure because of projections on cover. Cover must be not less than ½ inch in thickness including projections for securing rubber stoppers in metal containers, and must have a formed molding around its entire perimeter to match and tightly fit channels or indentations in the body flange.

(b) Tests: Each inside metal and rubber container must be adequately tested and inspected during manufacture to insure against leakage.

§ 178.176-5 Closure.

(a) Top of rubber liner must be firmly fastened to wooden cover of outside container so as to fit securely into ¾-inch recess provided by top cleats on box. Top of liner must have projections on the inside which bear directly on rubber stoppers of metal containers to secure them in place. When closure is effected the liner must provide a postive seal against interior leakage. Cover of wooden outside container must be securely fastened to body of container by means of trunk clasps affixed to each face of the box. The trunk clasps must be recessed into cover and top cleats to furnish a smooth bearing surface on all faces of the box.

§ 178.176-6 Marking.

(a) Marking on each box with letters and figures at least ½-inch high in rectangle as follows:

DOT-15L

(b) Each box must also be marked with the name or symbol of person making the mark specified in paragraph (a) of this section. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.177 Specification 15M; wooden boxes, metal lined, with inside containers for desensitized liquid explosives.

§ 178.177-1 Compliance.

(a) Required in all details.

§ 178.177-2 Size and capacity.

(a) Each outside wooden container shall contain not more than 6 inside metal containers having nominal capacity of 10 quarts each.

§ 178.177-3 Outside containers.

(a) Wooden boxes cleated as prescribed. Parts must be in close contact and completely enclose inside containers. Lumber must be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with assembly, or other defects that materially lessen the strength.

(1) The box shall be lined with copper or other nonsparking metal having suitable strength. All seams must be soldered, welded, or braced to produce a liquid-tight container having no openings in the bottom, sides, or ends.

(b) *Assembly:* Use brass screws throughout, countersunk and with heads covered with suitable wood filling compound. Any screw used to secure a metal attachment shall be soldered, welded, or brazed thereto. Metal parts used in the construction of or attached to the box or cover must be of nonsparking type. Fasten bottom securely with edges flush with sides and ends of box. Cleats must extend around entire perimeter of box. Apply top and bottom cleats horizontally. Bottom cleats must be flush with bottom surface of the box. Top cleats must extend above top of box to provide a ¾-inch recess for cover projections (§ 178.177-5). Cover must be flush with outside surface of top cleats. Cleats may be mitered but must butt at all corners.

(c) *Cellular construction:* The interior of the box shall be divided into cells by means of removable, nonmetallic, nonsparking dividers, into which the rubber boots or secondary containers fit snugly. The cells shall be of such size as to extend from the bottom to near the top of the rubber boots or secondary containers.

(d) Parts and dimensions as follows:

[Minimum dimensions in inches]

Thickness, sides, top, bottom, and end	Top cleats	Bottom cleats	Clover cleats
⅝	⅝ × 3⅛	⅝ × 2¾	¾ × 2

§ 178.177-4 Inside containers.

(a) Inside containers must be as follows:

(1) *Metal containers.* The individual inside containers shall be made in a workmanship manner, of copper or other nonsparking material of suitable strength, with all seams soldered, welded, or brazed to be liquid tight. The top shall be fitted with a securely attached carrying handle of copper or other nonsparking material of suitable strength. Each inside container must have a filling and pouring spout in the top, which shall be securely closed with rubber stoppers, paraffin, or oil-treated corks or other nonmetallic, nonsparking closures which are resistant to absorption of the contents and which provide a leakproof seal. The closures shall be secured in such manner as to prevent loosening, displacement, and leakage of contents during transit. Each inside container may have sufficient capacity in excess of 10 quarts to provide for outage requirements. Each side of the container must be strengthened vertically by at least 3 equally spaced indented crimps.

(2) *Rubber boots or secondary containers.* Each inside metal container must be contained in a rubber boot or other similar suitable leakproof, nonmetallic, nonabsorbent outer container, which must fit snugly in cellular structure provided in § 178.177-3(c). The rubber boot or secondary container must be liquid tight and shall be so constructed as to have an inside height approximately that of the inside metal container plus closure and otherwise so constructed that the bottom will provide cushioning for the inner container.

(b) Tests: Each inside metal and rubber or secondary container must be adequately tested and inspected during manufacture to insure against leakage.

§ 178.177-5 Closure.

(a) The box cover must be securely fastened to the box in a manner to prevent movement of the insider containers. The inner surface of the box cover must be lined with suitable coating material or sheathed with nonsparking metal to provide a nonabsorbent surface. The cover must be secured to the box by means of nylon, or other suitable straps and be so positioned to furnish a smooth bearing surface on all faces of the box. There shall be no protruding parts on the box or cover which would result in metal-to-metal contact.

§ 178.177-6 Marking.

(a) Marking on each box with letters and figures at least ½ inch high in rectangle as follows:

DOT-15M

(b) Each box must also be marked with the name or symbol of person making the mark specified in paragraph (a) of this section. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.181 Specification 15X; wooden boxes for two five-gallon cans.

§ 178.181-1 Compliance.

(a) Required in all details.

§ 178.181-2 Closed box.

(a) Parts and pieces to be in close contact.

§ 178.181-3 Ends.

(a) To be of group 1, 2, or 3 wood not over 2-piece.

§ 178.181-4 Sides top and bottom.

(a) To be of Group 1, 2, or 3 wood not over 3-piece.

§ 178.181-5 Two-piece ends and corrugated fasteners.

(a) *Two-piece ends.* Joints must be fastened with at least 3 corrugated fasteners.

(b) *Corrugated fasteners.* To be 1" wide and with penetration of ½ inch.

§ 178.181-6 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

§ 178.181-7 Groupings of principal woods.

(a) Grouping as follows:

Group 1

White pine.
Norway pine.
Aspen (popple).
Spruce.
Western (yellow) pine.
Cottonwood.
Balsam fir.
Yellow poplar
Chestnut.
Sugar pine.
Cypress.
Basswood.
Willow.
Noble fir.
Magnolia.
Buckeye.
White fir.
Cedar.
Redwood.
Butternut.
Cucumber.
Alpine fir.
Lodgepole pine.
Jackpine.

Group 2

Southern yellow pine.
Larch (tamarack).
Hemlock.
North Carolina pine.
Douglas fir.

Group 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black gum.
Black ash.
Tupelo.
Maple, soft or silver.

§ 178.181-8 Width of pieces.

(a) At least 2" for sides, top and bottom if in two pieces, or 2⅜" for tops and bottoms and at least 4" for sides if in three pieces.

§ 178.181-9 Thickness of lumber.

(a) Thickness as follows:

(1) Ends: Thickness to be not less than ¾" for Group 1 or 2 lumber and $\frac{11}{16}$" for Group 3 lumber.

(2) Sides, top and bottom: Thickness to be not less than ⅜".

§ 178.181-10 Assembly.

(a) By nailing with either bright or cement-coated nails, size and spacing as follows:

(1) Top to each end: 5 nails (1⅛" by 12½ gauge).

(2) Bottom to each end: 6 nails (1¾" by 12 gauge).

(3) Sides to each end: 6 nails (1½" by 12½ gauge).

§ 178.181-11 Marking.

(a) Marking on each box in letters and figures at least ½" high in a rectangle as follows:

DOT-15X

(b) Each box must also be marked with the name or symbol of person making the mark specified in paragraph (a) of this section. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.181-12 Inside can.

(a) Size: Approximate dimensions 9⅜×9⅜×13$\frac{15}{16}$ inches.

(b) Approximate capacity: 1,188 cu. in.

(c) Top: Embossed.
Seams: Crimped and soldered.
Closure: Airtight and leakproof.
Handles: Wire.

(d) Bottom: Embossed.
Seams: Crimped and soldered.

(e) Body: Paneled on 4 sides.
Two seams: Clinched and soldered.

(f) Material: IC (107 lb.) tin or terneplate.

(g) Average weight: 2 pounds 8 ounces.

(h) Marking: No specification marking required.

§ 178.182 Specification 15P; glued plywood, or wooden box for inside containers.

§ 178.182-1 Material requirements.

(a) Lumber or plywood must be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength and in accordance with the following:

(1) Lumber must be of good commercial grade.

(2) Plywood sections shall be firmly glued together with waterproof glue. A section of plywood from any part when immersed in water at room temperature for 48 hours shall show no delamination or separation of plies to qualify glue as waterproof.

§ 178.182-2 Construction requirements.

(a) Box shall be constructed of wood or of plywood not less than three-ply fabrication and shall be constructed so as to completely and snugly enclose body of the inside container, and so formed that inside container cannot permanently change position and be of sufficiently strong wood or plywood to withstand prescribed tests without serious rupture of or damage to box that would cause failure or lead to impending failure of inside container.

NOTE 1: Vertical openings not exceeding ⅜ inch in width and extending to within 3 inches of top or bottom on two opposite sides of box are permitted.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.182-3 Tests.

(a) One sample, taken at random and with inner container filled to marked capacity with water and closed as for use, shall be capable of withstanding prescribed tests without leakage. Tests shall be made of each size by each company starting production. The type tests are as follows:

(1) Complete package must be capable of withstanding two drops from a height of 4 feet onto solid concrete, the first drop to be made diagonally so top corner will strike the concrete; the second drop onto a 2 inch by 6 inch timber resting on the concrete with the 6 inch leg vertical, the drop being made with the box in a horizontal position and at right angles to the timber so that impact is near the center of the box side-wall.

(2) Additional tests as required by inside container specification.

(b) Records of tests performed under this specification must be retained by the manufacturer for a period of one year following discontinuance of production.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.182-4 Marking.

(a) Each outside container must be plainly marked with letters and figures at least ¾ inch high applied by hot branding iron or dark colored printing ink with pressure dies as follows:

(1) DOT-15P.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38180, Sept. 9, 1976]

§ 178.185 Specification 16A; plywood or wooden boxes, wirebound.

§ 178.185-1 Compliance.

(a) Required in all details. Authorized tolerances. Cleats, battens, and handles, minus $1/32''$; single thickness veneer, minus 5 percent; resawn boards, $1/64''$ below specified thickness for boards up to 7/32" thick and 1/32" below specified thickness for boards, 1/4" or more thick.

§ 178.185-2 Lumber or plywood.

(a) Lumber shall be well seasoned and commercially dry; free from decay, objectionable knots, slanting shakes, sharp cross grain, and other defects that materially lessen the strength. Grain of wood in cleats and battens must not cross piece with its length.

(b) Plywood shall be made from veneer which has been rotary cut, sliced, or sawed. Plywood shall be good commercial box or sheating grade and shall be moisture-resistant; free from decay, objectionable knots that interfere with nailings, splits, gaps, and other defects that materially lessen the strength.

(1) Moisture-resistant plywood shall be fabricated with either synthetic or protein type glue. Specimens for testing shall be not less than 5 in number measuring 6" × 6", and shall withstand 10 cycles of 4 hours immersion in water at room temperature and drying for 20 hours at a temperature not over 100° F. After 10 cycles, 4 of the 5 samples are to show not more than a sum total of 2-inch delamination on the edges, with depth delamination no greater than 1/2 inch.

§ 178.185-3 Wires.

(a) Of annealed steel, or other metal of equal strength. Washburn and Moen sizes.

§ 178.185-4 Staples.

(a) Wire size, Washburn and Moen.

§ 178.185-5 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.
Norway pine.
Aspen (popple).
Spruce.
Western yellow pine.
Cottonwood.
Willow.
Magnolia.
Buckeye.
White fir.
Cedar.
Redwood.
Yellow poplar.
Balsam fir.
Chestnut.
Sugar pine.
Cypress.
Basswood.
Noble fir.
Butternut.
Alpine fir.
Cucumber.
Lodgepole pine.
Jack pine.

GROUP 2

Southern yellow pine.
Hemlock.
North Carolina pine.
Douglas fir.
Larch (tamarack).

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black ash.
Black gum.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
White ash.
Hickory.

§ 178.185-6 Closed box.

(a) Parts and pieces with edges in close contact to give completely closed box.

§ 178.185-7 Top, sides, and bottom.

(a) Each cleated at both ends; intermediate rows of cleats authorized.

§ 178.185-8 Cleats.

(a) Ends mitered or with mortise and tenon joints.

(b) Cleats for plywood boxes shall be Group 4 woods.

§ 178.185-9 Ends.

(a) Battened when prescribed. Wired ends authorized provided wires run cross grain and terminate in loops with ends of wire driven through end board and clinched. Grain of wood and outside ply of plywood shall be perpendicular to sides except for wired ends.

(b) As provided by § 173.65(a)(1), Note 1, of this chapter, wooden boxes having inside metal containers which are tightly and securely closed, may be equipped with hand holes in each end which must be not more than one inch by four inches and centered laterally not nearer than 1⅝ inches from top edge of end of box.

§ 178.185-10 Wires.

(a) One wire over each row of cleats; intermediate wires as prescribed.

§ 178.185-11 Stapling.

(a) Staples for wires over cleats driven through boards into cleats and anchored; others through boards and clinched.

§ 178.185-12 Thickness of boards or plywood (sides, tops, bottoms, and ends).

(a) Thickness as follows except that, for thicknesses prescribed as $\frac{3}{16}$" or less, resawn boards must be $\frac{1}{64}$" thicker for each resawn surface:

Group of wood	Minimum thickness of boards (inch)						
	$\frac{1}{8}$ (0.125)	$\frac{1}{7}$ (0.143)	$\frac{1}{6}$ (0.167)	$\frac{3}{16}$ (0.185)	$\frac{7}{32}$ (0.219)	$\frac{1}{4}$ (0.250)	$\frac{5}{16}$ (0.313)
	Authorized gross weight, box and contents, not over (pounds)						
....	25	35	50	75	100	150	200
....	35	50	75	100	150	200	315
....	50	75	100	150	200	315	400
....	75	100	150	200	315	400	....

(1) For boxes with 3 or more rows of cleats, boards of the next lower thickness prescribed in the table are acceptable.

(b)

Group of wood	Minimum thickness of plywood (inch) [1]		
	$\frac{1}{8}$ (0.125)	$\frac{3}{20}$ (0-150)	$\frac{3}{16}$ (0-188)
	Authorized gross weight, box and contents, not over (pounds)		
4	150	300	400

[1] Minimum tolerance of 5% permitted for specified thickness.

§ 178.185-13 Size of cleats.

(a) At least $\frac{13}{16}$" by $\frac{13}{16}$" when thickness required for boards exceeds $\frac{1}{7}$"; otherwise at least $\frac{9}{16}$" by $\frac{13}{16}$".

§ 178.185-14 Binding wires (sides, top, and bottom).

(a) Spacing not over 8".

Exception: When each binding wire is stapled to a row of cleats, 11" spacing is authorized.

(b) Number and size of binding wires as follows:

Number of wires	Minimum gauge of wires, Washburn and Moen				
	16	15	14	13	12
	Authorized gross weight, box and contents (pounds)				
2	35	50	75	100	150
3	50	75	100	150	200
4	75	100	150	200	315
5	100	150	200	315	400
6	....	200	315	400	....
7	....	....	400	....	....

§ 178.185-15 Wires for wired ends.

(a) At least 2 wires on each end, size not less than as specified for binding wires in § 178.185-14, and spaced as follows:

Thickness of end (inch)	Maximum spacing	
	Between wires (inch)	Wires to cleats (inch)
0.125	6	4
.143	6	4
.167	6½	4
.187	6½	4
.219	7	4
.270	7	4
.313	7	4

(b) Ends less than 10 inches deep are authorized with 1 wire provided they are reinforced by 2 strips (liners), at least 1¼" wide and as thick as ends, securely stapled along edges of the end parallel to the wires.

§ 178.185–16 Staple spacing (approximate) and minimum size.

(a) Staples into cleats 16 gauge, Washburn and Moen, and:

(1) One and one-fourth inches long with 1½-inch spacing, or 1⅛ inches long with 1-inch spacing, when boards are over ¼-inch thick.

(2) One and one-eighth inches long with 1½" spacing, for boards ¼" thick or less; except that staples ⅞" long with 1½" spacing are authorized when boards are ½" thick or less.

(b) Other staples 18 gauge, Washburn and Moen.

§ 178.185–17 End supporting battens.[1]

(a) End supporting battens at least 1⅛" wide and same thickness as cleats; fastened securely across ends parallel to side cleats; required so that unsupported distance between cleats, battens, and between cleats and battens will be not greater than as follows.

Thickness of ends (inch)	Maximum spacing (inches)
0.125	10
0.143	11
0.167	12
0.187	13
0.219	14
0.250	15
0.313	16

§ 178.185–18 Side cleat battens and wired end supports.

(a) *Side cleat battens.* At least ¹³⁄₁₆" by ¹³⁄₁₆"; fastened securely to ends so as to be adjacent to side cleats when box is set up; required, in addition to any other battens, when authorized gross weight exceeds the following:

Group of wood in cleats	Authorized gross weight, box and contents, over (pounds)
1	100
2	150
3	200
4	200

(b) *Wired end supports.* Wired ends for boxes for authorized gross weight exceeding the foregoing, must be reinforced by 2 strips (liners), at least 1¼" wide and as thick as ends, securely stapled along edges of the end parallel to the wires; side cleat battens not required.

§ 178.185–19 Marking.

(a) Marking on each box with letters and figures at least ½" high in rectangle as follows:

DOT-16A***

(1) Stars must be replaced by maximum authorized gross weight (for example, DOT-16A150, etc.).

(b) The name or symbol of person making the marks specified in paragraph (a) of this section must be located just above, below, or following those marks. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.185–20 Setting up and closing.

(a) Nail or staple unwired ends to side cleats at intervals not over 2½"; fasten wired ends securely by means of loop fasteners.

(b) Twist ends of binding wires or bend loops to give tight closure.

(c) Nail at least 2 nails through side cleats into each side-cleat batten at not over 4" intervals; nail through top and bottom cleats with one 7-penny nail into each end of end-supporting battens.

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[1] Not required for wired ends less than 20 inches long.

§ 178.185–22 Special box authorized only when used in conjunction with inside spec. 2U (§ 178.24 of this chapter) polyethylene 5- and 15-gallon cubical containers.

(a) The boxes shall comply with spec. 16A requirements using the table for a gross weight of 200 pounds for construction purposes only, except as follows:

(1) The top section of boxes may have a hole not over $4\frac{1}{8}$ inches in diameter midway between the cleats, and centered not less than $3\frac{3}{16}$ inches from either the back or front edge of boxes.

(2) Five-gallon capacity—ends. Ends may be made from $\frac{1}{8}$ inch or thicker veneer and have only one 14-gauge wire across face. One-eighth inch veneer liners, at least $1\frac{1}{4}$ inches wide, must be stapled across the top and bottom of the ends.

(i) Fifteen-gallon capacity—ends. Ends must be made with same thickness faceboard material as the sides, top, and bottom and must have two liners of the same thickness, at least 3 inches wide, fastened by two rows of staples. Ends may have one 13-gauge wire across face.

(3) Paper overlaid veneer having veneer core of group 3 or 4 wood and completely covered on each side with 42 pound basis weight kraft paper securely adhered thereto by moisture resistant adhesive, is authorized. Total combined thickness of finished board shall be not less than 0.160 inch.

(4) Wire spacing for 5-gallon capacity containers. Binding wires stapled to a row of cleats may be spaced not more than 13 inches apart.

(b) Wirebound wooden or paper overlaid veneer board boxes must be provided with full size double-faced corrugated liners of at least 125-pound test (Mullen or Cady) for bottom and sides. Full area top pad is required for 5-gallon capacity containers and must be a minimum of 200-pound test (Mullen or Cady). Full area top pad is required for the 15-gallon capacity container and must be a minimum of 275-pound test (Mullen or Cady).

(c) Marking required:

(1) Marking on each box with letters and figures at least $\frac{1}{2}$ inch high in rectangle as follows:

DOT-16A-C

(2) The name or symbol of person making the mark specified in paragraph (c)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–40, 41 FR 38182, Sept. 9, 1976]

§ 178.186 Specification 16B; wooden boxes, wirebound.

§ 178.186–1 Compliance.

(a) Required in all details. Authorized tolerances: Cleats, battens, and handles, minus $\frac{1}{32}$"; single thickness veneer, minus 5 percent: resawn boards, $\frac{1}{64}$" below specified thickness for boards up to $\frac{7}{32}$" thick and $\frac{1}{32}$" below specified thickness for boards $\frac{1}{4}$" or more thick.

§ 178.186–2 Lumber.

(a) Well seasoned and commercially dry; free from decay, objectionable knots, slanting shakes, sharp cross grain, and other defects that materially lessen the strength. Grain of wood in cleats and battens must not cross piece within its length.

§ 178.186–3 Wires.

(a) Of annealed steel, or other metal of equal strength. Washburn and Moen sizes.

§ 178.186–4 Staples.

(a) Wire size, Washburn and Moen.

§ 178.186–5 Grouping of principal woods.

(a) Groupings as follows:

GROUP 1

White pine.
Norway pine.
Aspen (popple).

Spruce.
Western yellow pine.
Cottonwood.
Yellow poplar.
Balsam fir.
Chestnut.
Sugar pine.
Cypress.
Basswood.
Noble fir.
Willow.
Magnolia.
Buckeye.
White fir.
Cedar.
Redwood.
Butternut.
Alpine fir.
Cucumber.
Lodgepole pine.
Jack pine.

GROUP 2

Southern yellow pine.
Hemlock.
North Carolina pine.
Douglas fir.
Larch (tamarack).

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black ash.
Black gum.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
White ash.
Hickory.

§ 178.186–6 Closed box.

(a) Parts and pieces with edges in close contact to give completely closed box except that spaces 1½" are authorized between side boards and between top boards when boards are at least 3½" wide.

(b) Handles: Containers may be provided with suitable handles at discretion of shipper. When used, they must be securely fastened along tops of sides under wires and project 3 inches or be mounted on end cleats; extensions of side boards acceptable; dimensions as follows:

Authorized, gross weight not over (pounds)	Handles[1] minimum cross section (inches)
150	½×2½
200	⅝×2½
315	⅝×3½
400	13⁄16×3½

[1] Also ridge reinforcing battens when prescribed.

§ 178.186–7 Top, sides, and bottom.

(a) Each cleated at both ends; intermediate rows of cleats authorized.

§ 178.186–8 Cleats.

(a) Ends mitered or with mortise and tenon joints.

§ 178.186–9 Ends.

(a) Battened when prescribed. Wired ends authorized provided wires run cross grain and terminate in loops with ends of wire driven through end board and clinched. Grain of wood perpendicular to sides except for wired ends. Ridge-top containers, authorized as follows:

(1) Ends must be at least 2 times as thick as prescribed in § 178.186-12.

(2) Unsupported distance as prescribed in § 178.186–17 must not exceed 10" in any case.

(3) Ridge over 30" long must be reinforced on the outside, from end to end, by 2 battens with abutting edges and of cross section as prescribed for handles.

(4) Vertical grain unwired ends are authorized.

§ 178.186–10 Wires.

(a) One wire over each row of cleats; intermediate wires as prescribed.

§ 178.186–11 Stapling.

(a) Staples for wires over cleats driven through boards into cleats and anchored; others through boards and clinched.

§ 178.186–12 Thickness of boards (sides, tops, bottoms, and ends).

(a) Thickness as follows except that, for thicknesses prescribed as 3⁄16" or less, resawn boards must be 1⁄64" thicker for each resawn surface:

Group of wood	Minimum thickness of boards (inch)						
	1/8 (0.125)	1/7 (0.143)	1/6 (0.167)	3/16 (0.185)	7/32 (0.219)	1/4 (0.250)	5/16 (0.313)
	Authorized gross weight, box and contents (pounds)						
1	25	35	50	75	100	150	200
2	35	50	75	100	150	200	315
3	50	75	100	150	200	315	400
4	75	100	150	200	315	400	

(b) For boxes with 3 or more rows of cleats, boards of the next lower thickness prescribed in the table are acceptable.

§ 178.186-13 Size of cleats.

(a) At least 13/16" by 13/16" when thickness required for boards exceeds 1/7"; otherwise at least 9/16" by 13/16".

§ 178.186-14 Binding wires (side, top, and bottom).

(a) Spacing not over 8".

Exception. When each binding wire is stapled to a row of cleats, 11" spacing is authorized.

(b) Number and size of binding wires as follows:

Number of wires	Minimum gauge of wires, Washburn and Moen				
	16	15	14	13	12
	Authorized gross weight, box and contents (pounds)				
2	35	50	75	100	150
3	50	75	100	150	200
4	75	100	150	200	315
5	100	150	200	315	400
6		200	315	400	
7			400		

§ 178.186-15 Wires for wired ends.

(a) At least 2 wires on each end, size not less than as specified for binding wires in § 178.186-14, and spaced as follows:

Thickness of end (inch)	Maximum spacing	
	Between wires (inch)	Wires to cleats (inch)
0.125	6	4
.143	6	4
.167	6½	4
.187	6½	4
.219	7	4
.250	7	4
.313	7	4

(b) Ends less than 10 inches deep are authorized with 1 wire provided they are reinforced by 2 strips (liners), at least 1¼" wire and as thick as ends, securely stapled along edges of the end parallel to the wires.

§ 178.186-16 Staple spacing (approximate) and minimum size.

(a) Staples into cleats 16 gauge, Washburn and Moen, and:

(1) One and one-fourth inches long with 1½" spacing, or 1⅛" long with 1" spacing, when boards are over ¼" thick.

(2) One and one-eighth inches long with 1½" spacing, for boards ¼" thick or less; except that staples ⅞" long with 1½" spacing are authorized when boards are 1/7" thick or less.

(b) Other staples 18 gauge, Washburn and Moen.

§ 178.186-17 End supporting battens.[1]

(a) At least 1⅛" wide and same thickness as cleats; fastened securely across ends parallel to side cleats; required so that unsupported distance between cleats, battens, and between cleats and battens will be not greater than as follows:

---

[1] Not required for wired ends less than 20 inches long.

Thickness of ends (inch)	Maximum spacing (inches)
0.125	10
0.143	11
0.167	12
0.187	13
0.219	14
0.250	15
0.313	16

§ 178.186–18 Side cleat battens and wired end supports.

(a) *Side cleat battens.* At least 13/16" by 13/16"; fastened securely to ends so as to be adjacent to side cleats when box is set up; required, in addition to any other battens, when authorized gross weight exceeds the following:

Group of wood in cleats	Authorized gross weight, box and contents, over (pounds)
1	100
2	150
3	200
4	200

(b) *Wired end supports.* Wired ends, for boxes for authorized gross weight exceeding the foregoing, must be reinforced by 2 strips (liners), at least 1¼" wide and as thick as ends, securely stapled along edges of the end parallel to the wires; side cleat battens not required.

§ 178.186–19 Marking.

(a) Marking on each box with letters and figures at least ½" high in rectangle as follows.

DOT-16B***

(1) Stars must be replaced by maximum authorized gross weight (for example, DOT-16B315, etc.).

(b) The name or symbol of person making the marks specified in paragraph (a) of this section must be located just above, below, or following those marks. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–40, 41 FR 38182, Sept. 9, 1976]

§ 178.186–20 Setting up and closing.

(a) Nail or staple unwired ends to side cleats at intervals not over 2½"; fasten wired ends securely by means of loop fasteners. *Provided,* That ends at least 7/16" thick may be nailed with cement-coated nails through sides, top, and bottom of box into the ends at 3" intervals.

(b) Twist ends of binding wires or bend loops to give tight closure.

(c) Nail at least 2 nails through side cleats into each side-cleat batten at not over 4" intervals; nail through top and bottom cleats with one 7-penny nail into each end of end-supporting battens.

§ 178.186–21 Special box.

(a) Gross weight not over 500 pounds. Must comply with this specification except as follows: Sides, top, bottom, and ends, to be of group 2 or 3 wood having minimum thickness of ¼" for boxes not over 315 pounds gross weight, 5/16" for boxes not over 400 pounds gross weight, and ⅜" for boxes not over 500 pounds gross weight. Size of end cleats must be at least 13/16" × ⅞" and ends must have horizontal supporting battens at least 1⅜" × 13/16". One batten is required for boxes not over 200 pounds gross weight and three battens for others. Ends must be held in place by one metal strap at least ⅝" × 0.020" completely around the box stapled to the middle end battens. When size of box will not permit the application of all prescribed binding wires during manufacture, the additional binding wires of prescribed number and size, or metal straps of equal number and strength, must be applied after closing. At least three-binding wires must be applied to boxes not over 200 pounds gross weight and at least four to boxes over 200 pounds gross weight by the box manufacturer. Binding wires for boxes over 400 pounds gross weight must be of size and number prescribed for boxes not over 400 pounds gross weight.

§ 178.187 Specification 16D; wooden wirebound overwrap for inside containers.

§ 178.187-1 Material requirements.

(a) Lumber shall be as follows:

(1) Lumber shall be well seasoned and commercially dry; free from decay, objectionable knots, slanting shakes, sharp cross grain, and other defects that materially lessen the strength. Grain of wood in cleats and battens must not cross piece within its length.

(2) Authorized tolerances; cleats, battens and handles, minus 1/32 inch; single thickness veneer, minus 5 percent; resawn boards, 1/64 inch below specified thickness for boards up to 7/32 inch thick and 1/32 inch below specified thickness for boards 1/4 inch or more thick.

(3) Woods authorized are in the following groups:

GROUP 2

Southern yellow pine.
Hemlock.
North Carolina pine.
Douglas fir.
Larch (tamarack).

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black ash.
Black gum.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
White ash.
Hickory.

(b) Binding wires and staples shall be as follows:

(1) Of annealed steel or other material of equal strength, Washburn and Moen sizes.

§ 178.187-2 Construction requirements.

(a) Wirebound overwrap for drum-type inside container shall be constructed in accordance with the following:

Wireboard containers	Marked capacity of inside containers			
	Not over 5 gallons	Not over 15 gallons	Not over 30 gallons	Not over 55 gallons
Faceboard thickness (sides only)				
Group 2 woods	1/8" veneer	1/4" resawn	5/16" resawn	3/8" resawn
Group 3 or 4 woods	do	do	1/4" resawn	Do.
Cleats, mitered				
Outside cleats. Group 2, 3, or 4 woods.	13/16" × 7/8"	13/16" × 7/8"	13/16" × 7/8"	13/16" × 7/8".
Binding wires				
Number and gauge over outside cleats.	2-14 gauge	2-12 gauge	2-11 gauge	2-11 gauge.
Number and gauge intermediate wires.	1-14 gauge	3-12 gauge	4-12 gauge	3-12 gauge. 2-12 gauge.
Staples (length, gauge and spacing)				
In outside cleats	1 1/8"-16 gauge	1 1/8"-16 gauge	1 1/8"-16 gauge	1 1/8"-16 gauge.
Over intermediate wires	3/8"-18 gauge	7/16'-18 gauge	7/16"-18 gauge	9/16"-18 gauge.
Maximum spaces between staples	1 3/4"	1 3/4"	1 3/4"	1 3/4".
Tops and bases (group 2, 3, or 4 woods)				
Faceboard thickness	1/4" resawn	3/8" resawn	9/16"	13/16".
Battens (2 required)	1 3/8" × 1/4"	13/16" × 7/8"	13/16" × 7/8"	1 5/8" × 7/8".
Staples or cement coated nails	11/16"-18 gauge	1 1/4"-16 gauge	22-4d nails	1 3/4"-14 gauge.

(1) Staples for wires over cleats driven through boards into cleats and anchored; others through boards and clinched.

(2) Container shall be closed with threaded loop fastener with "Z" clinch for all capacities except 5 gallons for which regular clinch is authorized.

(3) Where binding wire closure clinches contact inner container, 1½ inches wide water-resistant fabric cloth with plastic coated backing and pressure-sensitive adhesive or other suitable means shall be applied in a single strip across clinches, or other equally efficient methods may be used.

(b) Wirebound overwrap for bottle-type inside container shall be constructed in accordance with the following:

Wirebound containers	Marked capacity of inside containers		
	Not over 6½ gallons (rectangular overwrap)	Not over 13 gallons (rectangular overwrap)	Not over 13 gallons (cylindrical overwrap)
Faceboard thickness (sides only)			
Group 2 woods	5/16"	⅜"	⅜".
Group 3 woods	¼" resawn	5/16"	5/16".
Group 4 woods	do	do	Do.
Cleats			
Outside and interrupted cleats	13/16" × ⅞"	13/16" × ⅞"	13/16" × ⅝".
Intermediate cleats	5½" × ⅜"	5½" × ⅜"	Outside cleats only.
Binding wires			
Number and gauge over outside cleats	2-13 gauge	2-12 gauge	2-12 gauge.
Number and gauge over intermediate cleats in intermediate wires.	2-14 gauge (not over 5 gallons). 4-14 gauge (not over 6½ gallons).	4-13 gauge	Do.
Staples			
In outside and interrupted cleats	1¼"-16 gauge	1¼"-16	1⅛"-16 gauge.
In intermediate cleats	⅞"-16 gauge	⅞"-16 gauge	None.
Over intermediate wires	7/16"-18 gauge	½"-18 gauge	No 2" gap in staples required.
NOTE: A 2" gap between staples must be provided in the center of each line of staples over the intermediate cleats			
Top [1] [2]			
Face material thickness	9/16"	13/16"	9/16'.
Battens	1⅜" × 9/16"	1⅞" × 13/16"	⅞" × 13/16".
Base			
Face material thickness	⅜"	⅜"	9/16".
Edge strips	1¼" × ⅜"	3½" × ⅜"	⅞" × 13/16".
Center strips	3⅛" × ⅜"	do	(Battens.)

[1] A hole of suitable type may be left in top of box to provide for protruding neck of inner container.

[2] Exterior grade plywood ½" thick with no battens is authorized.

(1) Containers shall be closed with threaded loop fasteners using a regular clinch.

§ 178.187-3 Assembly.

(a) Overwrap shall be constructed to provide a snug fit for the inside container.

(b) Overwrap inside surfaces shall be reasonably smooth and free from projections which would damage inside container.

§ 178.187-4 Tests.

(a) Wirebound overwrap; when assembled as for use, shall withstand the tests prescribed for specified inside containers. The completed package must withstand these tests without serious rupture of the overwrap and without producing a condition of the overwrap that could result in potential damage to the inside container.

§ 178.187-5 Marking authorized.

(a) Marking on each overwrap with letters and figures at least ½ inch high in rectangle as follows:

DOT-16D

(b) The name or symbol of person making the mark specified in paragraph (a) of this section must be located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.190 Specification 19A; wooden boxes, glued plywood cleated.

§ 178.190-1 Compliance.

(a) Required in all details.

§ 178.190-2 Three-way corners.

(a) Three-way corners (when specified in §§ 178.190-3 to 178.190-13) shall be of type so nailing will be into edge grain of cleats, unless otherwise specified.

§ 178.190-3 Lumber.

(a) Well seasoned and commercially dry; free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength. Cleats to be free from knots and grain of wood must not cross cleat in less than one-half its length.

(b) To be at least 3-ply, except for cleats; each ply glued in place with grain at right angles to the one next.

§ 178.190-4 Nails.

(a) Cement coated and of size specified for "sinkers", "coolers", and "3-ply-veneer nails" as generally known to the trade.

§ 178.190-5 Grouping of principal woods.

(a) Grouping as follows:

GROUP 1

White pine.
Norway pine.
Aspen (popple).
Spruce.
Western (yellow) pine.
Cottonwood.
Yellow poplar.
Balsam fir.
Cedar.
Redwood.
Butternut.
Cucumber.
Chestnut.
Sugar pine.
Cypress.
Basswood.
Willow.
Noble fir.
Magnolia.
Buckeye.
White fir.
Alpine fir.
Lodgepole pine.
Jack pine.

GROUP 2

Southern yellow pine.
Hemlock.
North Carolina pine.
Douglas fir.
Larch (tamarack)

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black ash.
Black gum.
Tupelo.
Maple--soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
White ash.
Hickory.

§ 178.190-6 Three-way corners.

(a) Three-way corners required; except for authorized gross weight not over 75 pounds.

§ 178.190-7 Cleats required.

(a) Two on each face at opposite edges; others as necessary so that cleats are not over 12" apart. These to extend full length of face.

(b) Others, if necessary, to provide nailing surface at each box edge.

§ 178.190-8 Parts and dimensions.

(a) Parts and dimensions as follows:

Authorized gross weight (pounds)	Plywood minimum thickness[1]	Cleats of group 1 or 2 woods[1]		Cleats of groups 3 or 4 woods[1]	
		Minimum thickness	Minimum width	Minimum thickness	Minimum width
	Inches				
50	3/20	1/2	1 1/2	1/2	1 1/2
75	3/20	9/16	1 11/16	1/2	1 1/2
100	3/16	5/8	1 7/8	1/2	1 1/2

Authorized gross weight (pounds)	Plywood minimum thickness [1]	Cleats of group 1 or 2 woods [1]		Cleats of groups 3 or 4 woods [1]	
		Minimum thickness	Minimum width	Minimum thickness	Minimum width
150	3/16	11/16	2 1/16	½	1 ½
200	3/32	¾	2 ¼	9/16	1 11/16
300	3/32	13/16	2 7/16	⅝	1 ⅞
400	3/32	⅞	2 ⅝	11/16	2 1/16

[1] Variation authorized of ⅛ prescribed thickness of any part not to exceed 10 percent of its area. Cleats at least ½" thick, of cross section equivalent to prescribed cleats are authorized.

§ 178.190-9 Marking.

(a) Marking on each container with letters and figures at least ½" high in rectangle as follows:

DOT-19A***

(1) The stars must be replaced by authorized gross weight (for example, DOT-19A200).

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.190-10 Setting up and closing all boxes.

(a) Each edge of each plywood section secured with 3-ply-veneer cement coated nails, or staples, at 3" intervals as follows:

(1) To face of cleat; clinching required; cement coating optional.

(2) To edge of cleat; except when nailing through a cleat in which case nail as in § 178.190-13.

§ 178.190-11 Boxes with 3-way corners.

(a) Each cleat forming 3-way corner to be nailed with 2 nails at each end into edge of adjoining cleat.

§ 178.190-12 Boxes without 3-way corners.

(a) Each edge cleat to be nailed to cleat on adjoining face.

§ 178.190-13 Nails and nailing under §§ 178.190-11 and 178.190-12.

(a) To be cement coated and as follows:

Cleats—thickness (inch)	Nails—cement coated			
	Group 1 or 2 woods		Group 3 or 4 woods	
	Size (penny)	Spacing (inches)	Size (penny)	Spacing (inches)
½	5	1 ¾	4	1 ½
9/16	6	2	5	1 ¾
⅝	6	2	5	1 ¾
11/16	7	2 ¼	6	2
¾	7	2 ¼	6	2
13/16	8	2 ½	7	2 ¼
⅞	9	2 ¾	8	2 ½

§ 178.191 Specification 19B; wooden boxes, glued plywood, nailed.

§ 178.191-1 Compliance.

(a) Required in all details.

§ 178.191-2 Authorized gross weight.

(a) Authorized gross weight not to exceed 150 pounds.

§ 178.191-3 Plywood.

(a) Plywood shall be made from veneer which has been rotary cut, sliced or sawed. It shall be well seasoned and commercially dry; free from decay, objectionable knots, that interfere with nailing, splits, gaps, and other defects that materially lessen the strength. Plywood shall be of good commercial box or sheathing grade.

(b) Plywood shall be at least 5 ply; each ply alternately glued with the grain at right angles to the one next.

§ 178.191-4 Nails.

(a) Cement coated and of size specified for "sinkers" or "coolers" as generally known to the trade.

(b) Nail spacing as follows:

Nail (size) in penny	Maximum spacing when driven into end and corner posts	
	Side grain	End grain
	Inches	
Threepenny	1¼	1
Fourpenny	1½	1¼
Fivepenny	1¾	1½
Sixpenny	2	1¾
Sevenpenny	2¼	2
Eightpenny	2½	2¼
Ninepenny	2¾	2½
Tenpenny	3	2½

§ 178.191-5 Corner construction.

(a) Boxes exceeding 35 pounds gross weight must have 4 vertical corner posts, or other equally suitable devices or fasteners; nailed lap-joint permitted for others.

§ 178.191-6 Assembly.

(a) Assemble with grain of outer plywood face in the direction of the longest faces of the box and securely nail or fasten to corner posts or ends as provided in §§ 178.191-4 and 178.191-5.

§ 178.191-7 Special tests.

(a) Samples of each type and size manufactured, taken at random, and filled with dummy contents the shape and size of expected contents, or with sand or sawdust, to the gross weight at which container is marked, closed as for use, must be capable of withstanding the following tests without serious rupture or exposure of contents:

(1) 8 drops from height of 1 foot, one on each corner, onto solid concrete.

§ 178.191-8 Closing for shipment.

(a) Box to be securely closed. Nails, if used, must be as prescribed in § 178.191-3; hinges and hasps or other equally efficient device authorized.

§ 178.191-9 Marking.

(a) Marking on each container with letters and figures at least ½" high in rectangle as follows.

DOT-19B***

(1) The stars must be replaced by authorized gross weight (for example DOT-19B150).

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-21, 36 FR 18469, Sept. 15, 1971; Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.193 Specification 18B; wooden kits.

§ 178.193-1 Compliance.

(a) Required in all details.

§ 178.193-2 Tops and bottoms.

(a) Pieces to be glued together.

§ 178.193-3 Parts required and dimensions.

(a) Parts required and dimensions as follows:

Authorized gross weight (pounds)	Thickness (minimum)		Hoops (minimum)		
	Top and bottom (inch)	Staves (inch)	Number	Width (inch)	Gauge[1]
25	½	⅜	3	5/16	23
40	½	½	3	⅝	23

[1] Birmingham wire gauge (number).

§ 178.193-4 Middle hoop.

(a) Middle hoop of No. 11 gauge wire authorized.

§ 178.193-5 Type test.

(a) Sample, filled with dry, finely powdered material to authorized gross weight and closed as for use, shall withstand, without leaking, a drop from height of 4 feet onto solid concrete so as to strike diagonally on top chime.

§ 178.193-6 Marking.

(a) Marking on each container plainly as follows:

(1) DOT-18B; followed by the authorized gross weight (for example, DOT-18B25).

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.193-7 Size of mark.

(a) Size of mark (minimum). ½" high.

§ 178.194 Specification 20WC wooden protective jacket.

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974]

§ 178.194-1 General requirements.

(a) Each jacket must meet the applicable requirements of § 173.24 of this subchapter.

(b) Maximum gross weight of the jacket plus the contents may not exceed the following:

(1) Specification 20WC-1: 225 kilograms (500 pounds).

(2) Specification 20WC-2: 225 kilograms (500 pounds).

(3) Specification 20WC-3: 455 kilograms (1000 pounds).

(4) Specification 20WC-4: 910 kilograms (2000 pounds).

(5) Specification 20WC-5: 1820 kilograms (4000 pounds).

(6) Specification 20WC-6: 2230 kilograms (6000 pounds).

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974]

§ 178.194-2 Materials of construction.

(a) The general configuration of the wooden protective jacket must be a hollow cylindrical shell constructed of one-piece discs and rings of plywood or solid hardwood reinforced with steel rods.

(1) The specification 20WC-2 must be additionally completely encased, snugly fit, within an 18-gauge steel shell. The steel shell must be provided with at least four 6 millimeter (0.25-inch) diameter vent holes. Each hole must be covered with durable weatherproof tape, or equivalent device.

(2) The specification 20WC-6 jacket must be additionally completely encased, snugly-fit, within a 12-gauge steel shell. The steel shell must be provided with at least twelve 1.2 centimeters (0.5-inch) diameter vent holes, located in 3 rows of 4 holes each, spaced at 90 degree intervals near the top, middle, and bottom of the drum. Each hole must be covered with durable weatherproof tape, or equivalent device.

(b) Plywood must be exterior-grade, void-free, Douglas fir (or equivalent) not more than 2.5 centimeters (1 inch) thick. Solid hardwood is authorized for specification 20WC-2 only.

(c) Discs and rings must be glued together with a strong, shock-resistant adhesive, such as either of the following:

(1) A resorcinol-formaldehyde adhesive, which has been bonded under both heat and pressure; or

(2) A polyvinyl-acetate emulsion, which has been reinforced with cement-coated nails. The nails must be randomly spaced and must be at least 2.5 times as long as the minimum thickness of the plywood discs or rings.

(d) Full-length steel rods are required for reinforcement and lid closure.

(1) The minimum number of rods and the minimum rod diameter are as shown in the following table:

Specification	Minimum number or rods	Minimum rod diameter	
		Inches	Millimeters
20WC-1	6	0.25	6.0
20WC-2	6	.25	6.0
20WC-3	12	.375	9.5
20WC-4	16	.375	9.5
20WC-5	16	.50	12.0
20WC-6	16	.50	12.0

(2) For specifications 20WC-1 and 20WC-2, steel rods must be equally spaced around the circumference to the rings and discs, midway between the O.D. and I.D. of the rings. For specifications 20WC-3 and 20WC-4, bolts may be staggered alternately in two rows, at ±1.2 centimeters (0.5-

inch) from the line midway between the O.D. and I.D. of the rings. For specifications 20WC-5 and 20WC-6, bolts may be staggered alternately in two rows at ±2.5 centimeters (1 inch) from the line midway between the O.D. and I.D. of the rings.

(3) Rod ends must be threaded and secured with lock nuts and steel washers, or equivalent device, to provide at least a 2.5 centimeters (1 inch) diameter bearing surface on each end. Ends of the rods must terminate 1.4 centimeters (0.75-inch) below the surface of the plywood for specifications 20WC-1 and 20WC-2. For specifications 20WC-3, 20WC-4, 20WC-5 and 20WC-6, the ends of the rods must terminate 3.7 centimeters (1.5 inches) below the surface of the plywood, and that portion of each end disc which extends beyond the rod ends must be further held in place with lag screws at least 10 centimeters (4 inches) long.

(e) Thickness of wooden shell:

(1) Specification 20WC-1: At least 10 centimeters (4 inches) thick.

(2) Specification 20WC-2: At least 7.5 centimeters (3 inches) thick.

(3) Specification 20WC-3: At least 13 centimeters (5 inches) thick for the jacket wall, and at least 15 centimeters (6 inches) thick for the end discs. In addition, at least 3 plywood chines, 5 centimeters (2 inches) wide and protruding 5 centimeters (2 inches) beyond the outer surfaces, must be located at each end and midway along the length of the jacket.

(4) Specification 20WC-4: At least 15 centimeters (6 inches) thick for the jacket wall, and at least 15 centimeters (6 inches) thick for the end discs. In addition, at least 3 plywood chines, 5 centimeters (2 inches) wide and protruding 5 centimeters (2 inches) beyond the outer surfaces, must be located at each end and midway along the length of the jacket.

(5) Specifications 20WC-5 and 20WC-6: At least 15 centimeters (6 inches) thick for the jacket wall, and at least 20 centimeters (8 inches) thick for the end discs. In addition, at least 5 plywood chines, 5 centimeters (2 inches) wide and protruding 5 centimeters (2 inches) beyond the outer surfaces, must be located at each end and equally spaced along the length of the jacket.

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974]

§ 178.194-3 Closure.

(a) Closure for the wooden protective jacket is provided by the steel reinforcing rods. The end cap (lid) must fit tightly to the body of the jacket to prevent a heat path to the inside of the jacket. The lid joint for specifications 20WC-3, 20WC-4, 20WC-5, and 20WC-6, may not be coplanar with the end of the inner containment vessel.

(b) Specifications 20WC-2 and 20WC-6. Locking ring closure, if used, must conform to § 178.104-4. Flanged closure, if used, must have at least 8 steel bolts (at least 6 millimeters (0.25-inch) diameter for 20WC-2 or 1.2 centimeters (0.50-inch) diameter for 20WC-6) and lock nuts (or equivalent device), spaced not more than 13 centimeters (5 inches) between centers.

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974]

§ 178.194-4 Tests.

Prior to each use, each jacket must be visually inspected for defects such as improper bonding, cracking, corrosion of steel rods, and improperly fitting closure lid, or other manufacturing defects. Particular attention must be given to any separation of the plywood discs and rings which would provide a heat path to the inside of the jacket.

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974]

§ 178.194-5 Painting.

Each jacket (other than 20WC-2 and 20WC-6) must be completely painted with a high quality exterior weather resistant paint.

[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974]

§ 178.194-6 Marking.

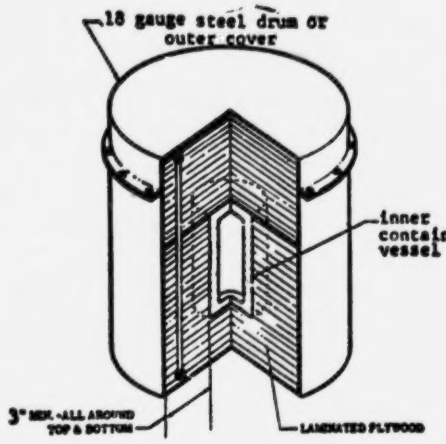
(a) Each jacket must be marked on the external surface as follows: "USA-DOT 20WC-( ) TYPE B." The appropriate numeral must be inserted in the marking to indicate the appropriate specification 20WC category: e.g., "20WC-2."

(b) Each jacket must also be marked with the name or symbol of person making the marks specified in paragraph (a) of this section. Symbol, if used, must be registered with the Associate Director for OE.

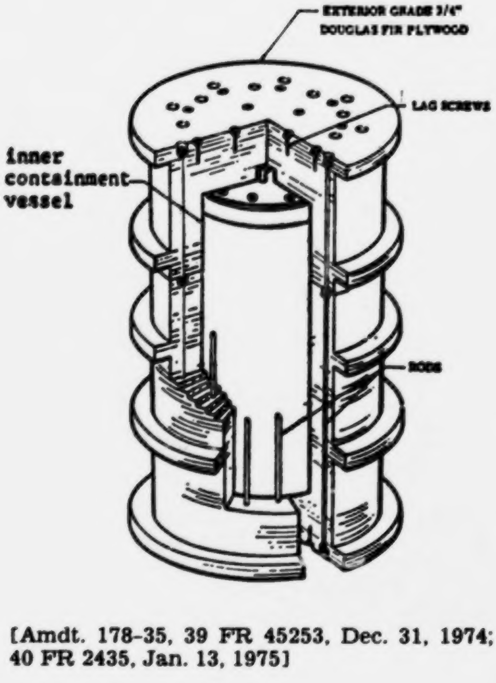
[Amdt. 178-35, 39 FR 45252, Dec. 31, 1974, as amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.194-7 Typical assembly sketches.

(a) Spec. 20WC-2.


18 gauge steel drum or outer cover
inner containment vessel
3" MIN.-ALL AROUND TOP & BOTTOM
LAMINATED PLYWOOD

(b) Spec. 20WC-5.



[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974; 40 FR 2435, Jan. 13, 1975]

§ 178.195 Specification 21WC wooden-steel protective overpack.

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974]

§ 178.195-1 General requirements.

(a) Each jacket must meet all the applicable requirements of § 173.24 of this subchapter.

(b) The maximum authorized gross weight of the overpack, including its inner container and contents may not exceed 1360 kilograms (3000 pounds).

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974]

§ 178.195-2 Materials of construction and other requirements.

(a) The general configuration of the protective overpack must be a combination of two nested plywood boxes, each 2.5 centimeters (1 inch) thick, nested within a third wooden box of nominal 5 centimeters (2-inch) thickness solid hardwood. The three nested boxes must be enclosed within a welded framework 10 cement-coated nails spaced on nominally 1 centimeter (⅜-inch) thick by 8-10 centimeters (3-4 inches) wide. All outer surfaces of each box must be coated with intumescent paint.

(b) Plywood must be exterior-grade, void-free, Douglas fir, or equivalent, at least 2.5 centimeters (1 inch) thick. Solid hardwood must be maple, or equivalent.

(c) All box joints and interior surfaces must be glued with a strong, shock-resistant adhesive such as polyvinylacetate emulsion, or equivalent.

(d) All hardwood joints must be mitered, or equivalent, reinforced with No. 10 cement-coated nails space on nominal 15 centimeters (6-inch) centers.

(e) All plywood joints must be butt-type, or equivalent, reinforced with No. 10 cement-coated nails spaced on nominal 15 centimeters (6-inch) centers.

(f) The angles and strapping of the metal frame must be spaced such that separation distances do not exceed 15 centimeters (6 inches).

(g) The lid must be of the same material as the box and fabricated in such a manner that closure forms a mitered joint with the hardwood box and 2 stepped-joints with the plywood boxes.

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974]

§ 178.195-3 Closure.

Closure for the protective overpack must be provided by at least 4 mild steel hinges formed from minimum 2.5-centimeter (1-inch) x 5-millimeter (3/16-inch) bar stock. Hinge pins must be minimum 6-millimeter (¼-inch) diameter by 13.3 centimeters (5¼ inches) long mild steel rod drilled at both ends for cotter pins.

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974]

§ 178.195-4 Tests.

Prior to each use, each overpack must be visually inspected for defects such as wood checking or splintering weld cracking, corrosion of steel parts, improper joint bonding, or improperly fitting closure lid.

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974]

§ 178.195-5 Required marking.

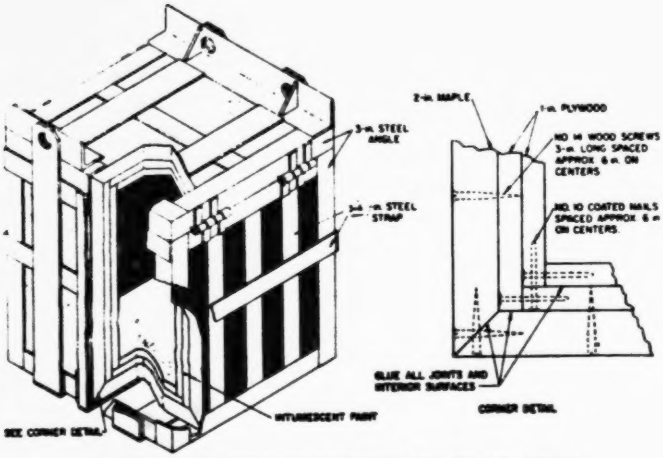
(a) Marking must be as prescribed in § 173.24 of this subchapter.

(b) Marking on the outside of each overpack must include the following:

(1) "USA-DOT 21WC" and "TYPE B" as appropriate.

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974]

§ 178.195-6 Typical assembly detail.


3-in. STEEL ANGLE
3/4 -in. STEEL STRAP
SEE CORNER DETAIL
INTUMESCENT PAINT
2-in. MAPLE
1-in. PLYWOOD
NO 14 WOOD SCREWS 3-in. LONG SPACED APPROX 6 in. ON CENTERS
NO. 10 COATED NAILS SPACED APPROX 6 in ON CENTERS.
GLUE ALL JOINTS AND INTERIOR SURFACES
CORNER DETAIL

RADIOISOTOPES SHIPPING CASK FIRE AND IMPACT SHIELD

[Amdt. 178-35, 39 FR 45253, Dec. 31, 1974; 40 FR 2435, Jan. 13, 1975]

§ 178.196 Specification 22A; wooden drums, glued plywood.

§ 178.196-1 Compliance.

(a) Required in all details.

§ 178.196-2 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

§ 178.196-3 Woods required for plywood.

(a) As follows:

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.

Black ash.
Black gum.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
White ash.
Hickory.

§ 178.196–4 Plywood.

(a) At least 2-ply for body and 3-ply for heads; all plies glued together cross grain.

§ 178.196–5 Hoops and battens.

(a) Grain of wood must not cross piece within ½ of its length. Hoops to be of elm.

Exception: Plywood hoops 0.28″ thick are authorized.

§ 178.196–6 Parts and dimensions.

(a) Parts and dimensions as follows:

Maximum net weights authorized (pounds)	Thickness (minimum)		Size of hoops (minimum)		Head liners (minimum)
	Body	Heads	Wooden	Metal[2]	
	Inches				
33	0.16	⅜	⅛×2	0.023×1 7/16 [1] .015×2⅜	⅓×⅝
56	.18	⅜	⅛×2	.023×1 7/16 .015×2 ⅜	⅓×⅝
115	.20	⅜	⅛×¼	.023×1 9/16 [1] .015×2⅜	¼×¾
200	.28	0.43	¼×3	.028×1 9/16	¼×¾

[1] Authorized only when metal hoop is between body of drum and wooden hoop as described in § 178.196–8.

[2] On drums of not over 10½ gallons capacity having authorized maximum net weights not over 115 pounds, additional outside headliners may be used in lieu of metal hoops provided containers will pass prescribed tests. (See § 178.196–14.)

§ 178.196–7 Body joints.

(a) To be made by steel strip 0.015″×1½″ secured by staples, clinched, at 1⅛″ centers, or by other method giving equivalent strength; also to be made sift-proof by 2 thicknesses of 3″ paper tape 60-pound strength, Mullen or Cady test, or other equivalent protection.

NOTE 1: Because of the present emergency and until further order of the Department, tape 2½″ wide may be used.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178–51, 43 FR 48645, Oct. 19, 1978]

§ 178.196–8 Hoops.

(a) One wooden and 1 metal required at each chime; wooden hoops secured by staples, clinched, at 3″ centers; metal hoops to be outside wooden hoops and secured by punching, or other equivalent method, at 6″ centers.

§ 178.196–9 Head battens.

(a) Required for heads over 15″ diameter; ¾″×3″, minimum; ends rounded to fit chime.

§ 178.196–10 Head liners.

(a) Required inside and outside for full circumference of heads. To be securely fastened by staples or nails, clinched.

§ 178.196–11 Head lining paper.

(a) Required for each head; 1½″ larger than head diameter; of No. 1 Kraft paper 90 pounds per ream (480 sheets 24″×36″) or equivalent.

NOTE 1: Because of the present emergency and until further order of the Department, a ream may consist of 500 sheets.

§ 178.196-12 Bung openings.

(a) Bung and bunghole authorized provided head lining paper is glued around hole.

§ 178.196-13 Insertion of head.

(a) As in § 178.196-16.

§ 178.196-14 Tests.

(a) Samples of each type and size taken at random, filled with dry, fine powder to the authorized net weight and closed as for use, must be capable of withstanding, without leakage, 2 drops diagonally on either end chime onto solid concrete from height of 4 feet.

§ 178.196-15 Marking.

(a) Marking on each container by marks ¾" high, as follows:

(1) DOT-22A, followed by authorized gross weight (authorized net weight plus approximate tare weight, for example, DOT-22A115).

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.196-16 Closing for shipment.

(a) *Closing heads.* Insert head lining paper, head, and head liner; nail with 15 gauge nails, clinched at 2" centers through head liner, body and wooden hoop; equivalent stapling authorized. Nail through steel hoop with two 7-penny nails into each end of head batten, if any.

§ 178.196-17 Bung closures.

(a) Bung closures (if any) must be well driven and secured sufficiently to prevent leakage in transit.

§ 178.197 Specification 22B; wooden drums, glued plywood.

§ 178.197-1 Compliance.

(a) Required in all details.

§ 178.197-2 Lumber.

(a) To be well seasoned, commercially dry, and free from decay, loose knots, knots that would interfere with nailing, and other defects that would materially lessen the strength.

§ 178.197-3 Woods required for plywood.

(a) Woods required as follows:

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black ash.
Black gum.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
White ash.
Hickory.

§ 178.197-4 Plywood.

(a) At least 2-ply for body and 3-ply for heads; all plies glued together cross grain.

§ 178.197-5 Hoops and battens.

(a) Grain of wood must not cross piece within ½ of its length. Hoops to be of elm. Exception: Plywood hoops 0.28" thick are authorized.

§ 178.197-6 Parts and dimensions.

(a) Parts and dimensions as follows:

Maximum net weights authorized (pounds)	Thickness (minimum)		Size of hoops		Head liners (minimum)
	Body	Heads	Wooden	Metal [2]	
	Inch				
33	0.16	⅜	⅛×2	0.023×1⁷⁄₁₆	⅓×⅝

Maximum net weights authorized (pounds)	Thickness (minimum)		Size of hoops		Head liners (minimum)
	Body	Heads	Wooden	Metal[2]	
	Inch				
56	.18	⅜	⅛ × 2	[1] .015 × 2⅜ .023 × 1 7/16	.... ⅓ × ⅝
115	.20	⅜	⅛ × 2¼	[1] .015 × 2⅜ .023 × 1 9/16	.... ¼ × ¾
200	.28	0.43	¼ × 3	[1] .015 × 2⅜ .028 × 1 9/16	.... ¼ × ¾

[1] Authorized only when metal hoop is between body of drum and wooden hoop as described in § 178.197-8.

[2] On drums of not over 10½ gallons capacity having authorized maximum net weights not over 115 pounds, additional outside headliners may be used in lieu of metal hoops provided containers will pass prescribed tests. (See § 178.197-13.)

§ 178.197-7 Body joint.

(a) Joint to be made by steel strip 0.015″×1½″ secured by staples, clinched, at 1⅛″ centers, or by other method giving equivalent strength.

§ 178.197-8 Hoops.

(a) One wooden and 1 metal required at each chime; wooden hoops secured by staples, clinched, at 3″ centers; metal hoops to be outside wooden hoops and secured by punching, or other equivalent method, at 6″ centers.

§ 178.197-9 Head battens.

(a) Required for heads over 15″ diameter ¾″×3″, minimum; ends rounded to fit chime.

§ 178.197-10 Head liners.

(a) Required inside and outside for full circumference of heads. To be securely fastened by staples or nails, clinched. Inside head liners not required when close fitting inside metal drum or strong container is used.

§ 178.197-11 Bung or other openings in head.

(a) Bung and bunghole authorized provided head lining paper is glued around hole. Holes are permitted in heads to provide for closing devices of inside metal drums or other strong inside containers when plywood drum is so equipped.

§ 178.197-12 Insertion of head.

(a) As in § 178.197-15.

§ 178.197-13 Tests.

(a) Samples of each type and size taken at random, filled with dry, fine powder to the authorized net weight and closed as for use, must be capable of withstanding, without leakage, 2 drops diagonally on either end chime onto solid concrete from height of 4 feet.

§ 178.197-14 Marking.

(a) Marking on each container by marks ¾″ high, as follows:

(1) DOT-22B, followed by authorized gross weight (authorized net weight plus approximate tare weight, for example, DOT-22B235).

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, below, or following that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.197-15 Closing for shipment.

(a) *Closing heads.* Insert head lining paper, head, and head liner; nail with 15 gauge nails, clinched at 2″ centers through head liner, body and wooden hoop; equivalent stapling authorized. Nail through steel hoop with two 7-penny nails into each end of head batten, if any.

§ 178.197-16 Bung closures.

(a) Bung closures (if any) must be well driven and secured sufficiently to prevent leakage in transit.

§ 178.198 Specification 22C; plywood drum for plastic inside container.

§ 178.198-1 Material requirements.

(a) Plywood shall be as follows:

(1) Plywood for body and heads shall be of good commercial or sheathing grade hardwood veneer. Veneer plies shall be firmly glued together with waterproof glue. A section of plywood from any part when immersed in water at room temperature for 48 hours shall show no delamination or separation of plies to qualify glue as waterproof.

(2) Plywood shall be well seasoned, commercially dry, and free from decay, loose knots that interfere with assembly, and other defects that would materially lessen the strength.

§ 178.198–2 Construction requirements.

(a) Plywood drum shall completely and snugly enclose body of inside container, or shall completely and snugly enclose body and neck of inside container. Top head of drum may have a hole of suitable size to provide for protruding neck of plastic container; bottom head may have drainage holes of suitable size. The following are required:

(1) Body shall be constructed of 2 shells, (see Note 1), butt-jointed, telescoped one within the other; outer shell shall be fastened on the outside with wire staples of not less than 17-gauge metal driven through a metal strip not less than 28-gauge by 1½ inches width and each side of body joint. Staples shall be spaced not more than 1½ inches apart and clinched on the inside. The grain of outside ply shall be paralleled and the grain of inner ply shall be vertical to plane of the heads.

NOTE 1: Each shell shall be of two-ply construction having minimum wall thickness of ⅙ inch for inside container not over 6½ gallons marked capacity and 2/11 inch for inside container not over 14 gallons marked capacity.

(2) Body heads shall be of at least three-ply construction with grain of alternate plies at right angles, circled to fit snugly within the body shell. Each head shall have a minimum thickness of ⅜ inch for inside container not over 6½ gallons marked capacity and 7/16 inch for inside container not over 14 gallons marked capacity. As an alternate, ½ inch thick pine bottom heads are authorized.

(3) Hoops shall be of at least three-ply construction with grain of alternate plies at right angles. Hoops shall be fastened to body shell so that ends butt or slightly gap by driving wire staples of at least 17-gauge metal through hoop and body and be clinched on the inside; staples spaced on not less than 3 inches centers. Each hoop shall not be less than 5/24 inch thickness by 2½ inches width for inside container not over 14 gallons marked capacity, and not less than ¼ inch thickness by 3 inches width for inside container not over 6½ gallons marked capacity.

(4) Head retaining rings shall be of hardwood veneer not less than ⅕ inch thickness by ⅝ inch width for inside container not over 6½ gallons marked capacity, and not less than 3/10 inch thickness by ¾ inch width for inside container not over 14 gallons marked capacity. The head retaining rings shall be fastened to the body shell with wire staples clinched on the inside of not less than 17-gauge metal spaced on 3 inch centers, except that bottom ring may be fastened by 14-gauge wire staples spaced on 4 inch centers.

(b) Plywood drum for plastic inside container not over 5 gallons marked capacity shall comply with requirements of § 178.198-1 (a) (1) and (2) and paragraph (a) of this section.

(1) Body shells shall be of two-ply construction having a minimum thickness of 2/11 inch and with grain of outside ply parallel and grain of inner ply vertical to plane of the heads. Body shall be butt-jointed and fastened on the outside with wire staples of not less than 17-gauge metal driven through a metal strip not less than 28-gauge by 1½ inches width and each side of body joint. Staples shall be spaced not more than 1½ inches apart and clinched on the inside.

(2) Body heads shall be of at least three-ply construction with grain of alternate plies at right angles circled to fit snugly within the body shell. Each head shall have a minimum thickness of ⅜ inch.

(3) Hoops shall be of hardwood veneer, not less than 2¼ inches wide by ⅛ inch thick. Hoops shall be fastened to the body by 17-gauge staples

on not less than three-inch centers and shall be overlapped not less than 3 inches.

(4) Head retaining rings shall be of hardwood veneer of ⅕ inch thickness by ¾ inch width except bottom rings may be two thicknesses, each ⅛ inch thickness by 1¾ inches width. Rings shall be fastened to body shell with wire staples of 17-gauge metal on not less than 3-inch centers and clinched on inner surface.

§ 178.198-3 Tests.

(a) Samples taken at random with inner plastic container filled to marked capacity with water and closed as for use, shall be capable of withstanding prescribed tests without leakage from inside container or breakage of outside container that would be of such a nature as to contribute to potential failure of inner container. Tests shall be made of each size by each company starting production. The type test is as follows:

(1) One 4-foot drop onto solid concrete so as to strike diagonally on either chime.

(2) Additional tests as required by inside container specification.

§ 178.198-4 Marking on outside container.

(a) Each outside container must be plainly marked with letters and figures at least ¾ inch high applied by hot branding iron or dark colored printing ink with high pressure dies as follows:

(1) DOT-22C.

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above, or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18927, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38180, Sept. 9, 1976]

Subpart F—Specifications for Fiberboard Boxes, Drums, and Mailing Tubes

Source: 29 FR 18951, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§ 178.205 Specification 12B; fiberboard boxes.

§ 178.205-1 Compliance.

(a) Required in all details.

§ 178.205-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box, except recessed flanged heads, are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 178.205-3 Classification of board.

(a) Fiberboard is hereby classified by strength[1] of completed board as in first column of the following table; weights specified in the table are the minimums authorized.

Classified strength[1] of completed board	Solid fiberboard-Minimum combined weight of component plies exclusive of adhesives (pounds per 1,000 sq. ft.)	Facings for corrugated fiberboard	
		Double faced—Minimum combined weight of facings (pounds per 1,000 sq. ft.)	Double wall—Minimum combined weight of facings including center liner (pounds per 1,000 sq. ft.)
175	149	75	
200	190	84	92
275	237	138	110
325	237	138	110
350	283	180	126
375	283	180	180
400	283	180	180
450	283	180	180

[1] Mullen or Cady test (minimum).

§ 178.205-4 Solid fiberboard.

(a) To be 3-ply or more; both outer plies water resistant.

§ 178.205-5 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1000 square feet; all parts must be securely glued together throughout all contact areas.

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[1] Mullen or Cady test (minimum).

§ 178.205-6 Stitching staples.

Stitching staples must be made in such a configuration that their holding capability as installed will not be less than that of flat steep staples $3/32 \times 0.019$ inch in cross section and not less than $7/16$-inch wide.

[Amdt. 178-12, 35 FR 11686, July 22, 1970]

§ 178.205-7 Tape.

(a) Coated with glue at least equal to No. 1¾ Peter Cooper standard. Cloth tape of strength, across the woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24"×36"); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape, except as provided in § 178.205-11(d). Other tapes of equal strength and efficiency are authorized.

(b) Tape for closure of slotted containers complying with the following requirements is authorized when applied as prescribed in § 178.205-17(a)(3):

(1) Tape must be not less than 3 inches wide and shall be made of two sheets of 100 percent sulfate Kraft each not less than 30 pounds basis weight, reinforced with glass, sisal, or rayon fiber, combined with a laminant of asphalt or other material not affected by temperature extremes any more than would standard 180°F. to 200°F. softening point asphalt.

(2) Tape must be reinforced by lengthwise fibers spaced not more than an average of ½ inch apart, and by crosswise fibers spaced not less than an average of 2 per inch except that when a diamond pattern is employed for crosswise reinforcement, the spacing between the parallel sides of the diamond measured in the machine direction must be not more than 1 inch.

(3) Glass or sisal reinforced tape must have a minimum tensile strength in the machine direction of 75 pounds per inch of width and a minimum tensile strength in the cross direction of 45 pounds per inch of width; rayon reinforced tape must have a minimum tensile strength in the machine direction of 57 pounds per inch of width and a minimum tensile strength in the cross direction of 27 pounds per inch of width with elongation not exceeding 15 percent. Tensile tests on the finished product shall be made on a 3-inch width sample.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 (e))

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.205-8 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(4) For corrugated fiberboard, doublepop tests may be disregarded.

§ 178.205-9 Types authorized.

(a) To be of solid or corrugated fiberboard of the following types, or as specifically provided for in § 178.205-19 to § 178.205-37;

(1) Slotted box; three-piece box without recessed ends; three-piece box of solid fiberboard with recessed ends; double-slide box; triple-slide box; telescope box, with sections of equal depth, or with covers, top or bottom or both, with 3 inches overlap. (See § 178.205-14 (d) for boxes with single-flap closures.)

§ 178.205-10 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 178.205-11 Joints.

(a) For solid and corrugated fiberboard slotted containers: Lapped 1½ inches from center of scoreline except as in § 178.205-12; stitched at 2½ inch intervals and within 1 inch of each end of joint; body joint must be double-stitched (2 parallel stitches) at each end of joint over 18 inches long.

(b) For corrugated fiberboard slotted containers only: One butt joint taped (See § 178.205-7) is authorized; 3 inch tape required for boxes over 30 pounds authorized gross weight and 2 inch tape for others.

(c) For triple and double slide boxes: Joints of all slides must be taped (see § 178.205-7) for stitched; 3-inch tape required for boxes over 30 pounds authorized gross weight and 2-inch for others.

(d) For corrugated fiberboard only: One butt joint taped inside and outside with strips of one thickness of sulphate paper not less than 2 inches wide extending entire length of joint and firmly glued to box. For boxes not exceeding 65 pounds gross weight, outside strip of sulphate paper to be of basis weight not less than 60 pounds testing not less than 60 pounds and inside strip of sulphate paper to be of basis weight not less than 40 pounds testing not less than 40 pounds. For boxes exceeding 65 pounds gross weight, outside and inside with strips of sulphate paper which must each be of basis weight not less than 90 pounds testing not less than 90 pounds. Basis weight of paper shown is for 500 sheets, 24×36 inches.

(1) For glued lap joint, the sides of box forming joint must lap not less than 1¼" and be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after the film application has dried.

§ 178.205-12 Flanged heads.

(a) Must have 4 flanges, at least 1" long above fillet, on each head. Recessed flanged heads not authorized for boxes of corrugated fiberboard.

§ 178.205-13 Seams which are to be stitched.

(a) Overlap, if any, required to be at least 1½ inches from center of scoreline except as in § 178.205-12.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App A to Part 1)

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.205-14 Flap closures.

(a) Fill-in pieces, of the same type fiberboard as used in construction of the container, are required where it is necessary to prevent an opening between the inner flaps, unless otherwise provided by paragraphs (b) and (c) of this section or by Part 173 of this chapter.

(b) If to be closed by adhesive, each inner flap must cover at least one-third of face; inner flaps must butt or have full overlap, or fill-in pieces must be used, unless otherwise provided by Part 173 of this chapter, except that fill-in pieces are not required when outer flaps have full overlap. Outer flaps must butt or have full overlap.

(c) In lieu of fill-in pieces between inner flaps which do not butt, the following is authorized when linings are not prescribed in § 178.205.16.

(1) Top and bottom pads the same dimensions as interior of container of solid or corrugated fiberboard at least 125 pound test (Mullen or Cady).

(2) Minimum combined weight of facings for corrugated fiberboard pads must be at least 52 pounds per thousand square feet.

(3) Minimum combined weight of component plies for solid fiberboard pads must be at least 114 pounds per thousand square feet, exclusive of adhesives.

(4) Complete inner box or boxes.

(d) Single-flap closures are authorized for boxes with one dimension not over 2"; each flap must be scored and form one of the small faces of the box and lap at least 5" on one of the largest faces.

[29 FR 18951, Dec. 29, 1964, as amended by Order 67, 30 FR 7425, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.205-15 Linings (when prescribed by § 178.205-16).

(a) Of 1-piece to extend around 4 faces with joint at center of 1 face and with 4 flanges, at least 1½" long, on each end (corners may be mitered) to bend over the other 2 faces; also 2 pads to cover the other 2 faces. Pads may be omitted if closing flaps afford 3 thicknesses throughout face. For boxes with 1 dimension not over 3", one of the widest flanges may be lengthened to cover entire face and lap 6" on the adjoining face and the other flanges and the pads may then be omitted.

[29 FR 18951, Dec. 29, 1964, as amended by Order 67, 30 FR 7425, June 5, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.205-16 Authorized gross weight and parts required.

(a) Authorized gross weight (when packed) and parts required as follows:

Authorized gross weight (pounds)	Strength of fiberboard (minimum) Mullen or Cady test						
	Solid board			Doublefaced corrugated		Doublewall corrugated	
	Box	Lining [2]	Heads [1]	Box	Lining [2]	Box	Lining [2]
15	175		([3])	175		200	
30	200		275	200		200	
40	275		350	275		200	
				200	175		
55	325		([3])	325		275	
	375		([3])	375			
65 [4]				275	175	275	
	275	175	350	200	200		

[1] For recessed heads when used. In other cases same as for box.

[2] As prescribed in § 178.205-15. A complete box is acceptable in place of the lining.

[3] Recessed heads not authorized in any case.

[4] Except as otherwise authorized herein or by Part 173 of this chapter.

(b) Triple slide boxes authorized for gross weights as follows: Of board at least 175-pound test for 40 pounds; of board at least 200-pound test for 65 pounds.

§ 178.205-17 Closing for shipment.

(a) Slotted container, by coating with adhesive the entire contact surfaces of closing flaps and fill-in pieces where required or as prescribed in paragraph (a) (1), (2), or (3) of this section.

(1) By stitching with staples as prescribed by § 178.205-6 at 2½-inch intervals along all seams (one 5-inch space allowed when necessary to permit use of stitching device); or with staples made of flat wire of hardness not less than equivalent of Rockwell B90, and not less than 0.037 inch thick and not less than 0.074 inch wide, with not less than 1¼ inch crown, may be spaced not more than 5 inches apart. Such staples may be used across center seam where outside flaps meet in lieu of on both sides of center seam but need only be used where outside flaps overlay inner flaps; or staples made of arcuate wire of hardness not less than equivalent of Rockwell B90, and not less than 0.027 inch thick and not less than 0.095 inch wide, with not less than 1 inch crown, may be spaced not more than 5 inches apart. Such stitches when spaced not more than 2½ inches apart may be used across center seam where outside flaps meet in lieu of on both sides of center seam but need only be used where outside flaps overlay inner flaps.

(2) For fiberboard boxes containing not more than 1 inside metal can not exceeding 1 gallon nominal capacity, and as otherwise authorized by Part 173 of this chapter, by application of 2 strips of pressure-sensitive tape not less than ½ inch in width, 1 strip to be placed approximately equal distance over the seam of abutting outer flaps, the other at a right angle to the first and spaced approximately equal distance on the closure face; strips must be of sufficient length to extend not less than 1 inch beyond score lines on side and end panels. Tape shall have a minimum tensile strength of 160

pounds per inch of width; minimum adhesion value of 18 ounces per inch of width; and minimum elongation of 12 percent at break, or having a minimum longitudinal tensile strength of not less than 240 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width and a minimum elongation of 3 percent at break.

(3) For slotted containers only, reinforced tape complying with the requirements of § 178.205-[illegible](b) is authorized for application over the center seam only. Tape must extend over the ends of box not less than 2½ inches.

(4) All closing flaps may be firmly glued with a hot-melt adhesive of 100 percent solid content of thermoplastic material which will maintain bond at temperature ranging from 20° F. below zero to 165° F. above zero. Adhesive must be applied in not less than eight stripes (except as specified below) on each inner flap, each stripe having a minimum width of 3⁄16-inch after compression. Stripes may not be more than 1½ inches apart and not less than four stripes must be applied on each side of center seam on each inner flap for full length of flap overlap area with one stripe not more than ½-inch from each side of center seam. If less than eight such stripes are applied on each inner flap, adhesive must cover and securely bond not less than 25 percent of flap contact area with bonded areas extending to within ½-inch or less of center seam.

(5) For regular slotted containers, pressure-sensitive tape is authorized for application over the center seams only and extending not less than two inches over the ends of the box. Tape must be not less than 2 inches wide and have a plastic film backing of polyester, polypropylene, or equivalent material. Tape must have a minimum tensile strength of 45 pounds per inch of width in the machine direction and not less than 55 pounds per inch of width in the cross direction and may not be affected by temperature extremes normally encountered during transportation. Boxes closed by means of this pressure-sensitive tape must be capable of passing performance tests prescribed in § 178.210-10.

(b) Double slide boxes or triple slide boxes, by coating the inner slides with adhesive, or by closing with reinforced tape capable of withstanding test prescribed by paragraph (b)(1) of this section; for single-flap closures as authorized for boxes with one dimension not over 2 inches, the flaps must be fastened to the body with adhesive.

(1) Boxes selected at random, containing dummy contents similar to that to be shipped and packed to authorized gross weight, closed with reinforced tape across the ends and onto opposite side panels at least 2 inches, must be capable of withstanding a drop on each end from a height of 4 feet onto solid concrete without closure failure.

(c) Fiberboard boxes with covers extending over sides but not to bottom, covers resting on walls of box, or telescope boxes of equal depth section, covers extending to bottom, must be secured by one of the following methods:

(1) By not less than three metal straps, one lengthwise and others at right angles thereto.

(2) When cover extends not less than 3 inches over the walls of the box, by coating with adhesive the entire contact area of the cover.

(3) Telescope boxes having equal depth sections may be closed by application of reinforced water activated tape or pressure sensitive tape under conditions and for commodities as prescribed in Part 173 of this chapter.

(d) When metal straps are specified, boxes must be strapped with the required number; size at least ⅝ inch×0.015 inch.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-41, 42 FR 28135, June 2, 1977]

§ 178.205-18 Marking.

(a) *On each container.* Symbol in rectangle as follows:

DOT-12B***

(1) Stars to be replaced by authorized gross weight (for example, DOT-12B40, etc.).

(2) Name and address or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) When metal straps are prescribed, boxes must be marked "——— (number) METAL STRAPS REQUIRED" just above or below the mark specified in this paragraph.

(4) Size of markings: Specification markings prescribed in paragraph (a)(1) of this section must be at least ½ inch high; other markings must be legible.

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.205-19 Special box; authorized only for contents in 1-gallon rectangular metal cans or cylindrical metal cans of 26 gauge material.

(a) Must comply with this specification except as follows: Must be 1-piece type, of double-wall corrugated fiberboard at least 400-pound test with all three facings at least 135-pound test; to be marked "FOR 1-GAL. CYLINDRICAL OR RECTANGULAR CANS ONLY" near the DOT specification mark; authorized gross weight 84 pounds.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.205-20 Special box; authorized only for proxylin in sheets, rods, or tubes.

(a) Must comply with this specification except as follows: Must be of board at least 275-pound test with lining at least 200-pound test, all being double-faced corrugated fiberboard; 3 metal straps required (see §§ 178.205-17 and 178.205-18); authorized gross weight 90 pounds.

§ 178.205-21 Special box; authorized only for proxylin in sheets, rods, or tubes.

(a) Must comply with this specification except as follows: Must be telescope type with wooden frame between the parts that telescope; authorized gross weight 90 pounds.

(b) Frame of group 3 or 4 wood 9/16" thick with lock corners glued.

GROUP 3

White elm.
Red gum.
Sycamore.
Pumpkin ash.
Black gum.
Black ash.
Tupelo.
Maple—soft or silver.

GROUP 4

Hard maple.
Beech.
Oak.
Hackberry.
Birch.
Rock elm.
Hickory.
White ash.

(c) Telescoping parts of double-faced corrugated fiberboard at least 400-pound test with facings at least 180 pounds per thousand square feet; each part of same depth as frame; outer part to have corners overlapped and securely fastened.

(d) Four metal straps required. Glued or stitched closure not required. (See §§ 178.205-17 and 178.205-18.)

§ 178.205-22 Special box; authorized only for motion-picture film in metal cans or strong cardboard or fiberboard boxes each containing not over 2,000 feet (approx.) of film.

(a) Must comply with this specification except as follows:

(1) *For one inside container.* Must be of board at least 275-pound test for a 2,000-foot film and of board at least 200-pound test for a 1,000-foot film; lining and pads not required; closure by taping with strong paper tape authorized.

(2) *For more than one inside container.* Must be of 1-piece type; authorized gross weight 55 pounds when made of 325-pound test board, 65 pounds when made of 375-pound test board, and 75 pounds when made of 450-pound test board; interior packing required, of fiberboard at least 175-pound test, adequate to support inside containers in center of outside container; lining and top and bottom pads not required.

§ 178.205-23 Special box; authorized only for poisonous solids, class B, in 1-gallon metal cans.

(a) Must comply with this specification except as follows: Must be 1-piece type, of double-wall corrugated fiberboard at least 400-pound test with all three facings at least 135-pound test; authorized gross weight 84 pounds.

§ 178.205-24 Special box; authorized only for fusees.

(a) Must comply with this specification except that the box must be constructed of double faced corrugated fiberboard at least 400-pound test or solid fiberboard of same strength. Lining and pads are not required. Authorized gross weight is 75 pounds. For fusees equipped with spikes, box-end protection as required in § 173.154a (a)(2) of this chapter must be provided.

[Amdt. 178-21, 36 FR 21202, Nov. 4, 1971]

§ 178.205-25 Special box; authorized only for wet electric storage batteries of the glass cell type or synthetic resin (plastic) type.

(a) Must comply with this specification except as follows: Must be one-piece type of double wall corrugated fiberboard at least 275-pound test; must have linings to extend around four faces with joint in center of or at end of one face but at no time may joint of box and joint of liner coincide; lining to be of sufficient height to support vertical scoring of box; lining to be made of double wall corrugated board with minimum test of 275 pounds, top of battery or batteries to be protected by trays or scored sheets of corrugated fiberboard having minimum test of 200 pounds; bottom of batteries to be protected by minimum of one excelsior pad or one double wall corrugated fiberboard pad; when one or more batteries are packed in same carton, batteries must be separated by a minimum of one thickness of double wall corrugated fiberboard having minimum test of 275 pounds; authorized gross weight 95 pounds.

§ 178.205-26 Special box; authorized only for one 5-gallon rectangular metal can, spec. 2F (§ 178.25 of this part); gross weight not to exceed 65 pounds.

(a) Must comply with this specification except as follows: Must be 1-piece type of double-wall corrugated fiberboard at least 350-pound test; must have top and bottom pads of double-wall corrugated fiberboard at least 350-pound test, pads to be double-flanged with flanges extending down the inside of carton at least four inches.

§ 178.205-27 Special box; authorized only for not more than two square inside metal cans each containing not over 200 feet (approx.) motion-picture film; gross weight not to exceed 15 pounds.

(a) Must comply with this specification except as follows: Must be double-slide type, both slides of double-faced corrugated fiberboard at least 200-pound test; closure by taping with strong paper tape authorized.

§ 178.205-28 Special box; authorized only for wet electric storage batteries of aluminum-case type, asphaltum composition, impregnated rubber, synthetic resin (plastic), or wooden-battery-box type, having a net weight greater than 75 pounds.

(a) Must comply with this specification except as follows: Must be one-piece type of double wall corrugated fiberboard at least 400-pound test, or solid fiberboard testing at least 400 pounds, boxes may or may not have hand holes provided for in ends of box providing same will not materially weaken box, top of battery to be protected by wood frame, corrugated trays or scored sheets of corrugated fiberboard having minimum test of 200 pounds, top protection must bear evenly on connectors of battery to facilitate stacking of batteries, bottom of batteries to be protected by minimum of one excelsior pad or double wall corrugated fiberboard pad; sides and ends to be cushioned between batteries and walls of box; combined thickness of cushioning material and walls of box must be not less than ½", cushioning to be of excelsior pads, corrugated fiberboard or other suitable cushioning material; no more than one battery to be packed per box, authorized gross weight 190 pounds.

§ 178.205-29 Special box; authorized only for ship distress signals in inside metal containers of not less than 24 gauge metal.

(a) Must comply with this specification except as follows: Must be one-piece type of double faced corrugated board at least 350-pound test, with top and bottom pads of the same material. Gross weight not to exceed 95 pounds.

§ 178.205-30 Special box; authorized only for toy torpedoes.

(a) Must comply with this specification and the following: Must be one-piece type fabricated of double-wall corrugated fiberboard having minimum strength of 350 pounds per square inch, Mullen or Cady test. Box shall be provided with double-face lining on all sides and top and bottom pads. Gross weight not to exceed 25 pounds.

§ 178.205-31 Special box; authorized only for commodities where spec. 12B is prescribed in Part 173 of this chapter.

(a) Box shall have not more than 1 inside glass container having screw cap closure or metal container not exceeding 32 ounces or 2 pounds net weight, which must fit snugly or be adequately cushioned to prevent movement. Box shall comply with this specification and be of one-piece folder type, so designed as to form double thickness of corrugated board on top, bottom, and ends. Fiberboard used in construction of the box shall have a minimum strength of 200 pounds per square inch, but for gross weight exceeding 8 pounds, the box must be constructed of at least 275-pound per square inch test fiberboard (Mullen or Cady). Closure must be equal in efficiency to that prescribed in § 178.205-17.

§ 178.205-32 Special box; authorized only for electrolyte (acid), corrosive battery fluid, hydrochloric acid mixtures of not over 28 percent strength, or cleaning compounds, liquids, containing not over 28 percent hydrochloric (muriatic) acid.

(a) Box shall have not more than 12 inside glass bottles, with acid-proof closures, of not over 32 ounces capacity each. Box shall comply with this specification and be constructed of at least 275-pound test (Mullen or Cady) double-wall corrugated fiberboard and be equipped with at least 125-pound test (Mullen or Cady) double-faced corrugated fiberboard scored sheets so designed as to provide two thicknesses of corrugated fiberboard between each bottle and one thickness between bottles and sides and ends of box. Top and bottom pads of the same size as the top and bottom area of the box and of at least 125-pound test (Mullen or Cady) double-faced corrugated board are required or box shall comply with this specification and be constructed of at least 325-pound test (Mullen or Cady) double-faced corrugated board and be equipped with at least 200-pound test (Mullen or Cady) corrugated fiberboard ½ inch extended cell slotted partitions so designed as to provide a void space between the ends and sides of outside box and the inside cell partition and shall be provided with top and bottom pads, of the same area as the box, of at least 200-pound test (Mullen or Cady) double-faced corrugated fiberboard.

§ 178.205-33 Special box; authorized only for electrolyte (acid) and alkaline corrosive battery fluid packed with storage batteries.

(a) Box shall be constructed of corrugated fiberboard having strength of not less than 200 pounds per square inch. Mullen or Cady test for maximum authorized gross weight not over 65 pounds. Top and bottom pads and fill-in pieces are not required when inner flaps do not meet. Box must otherwise comply with this specification. (See § 173.258(a)(3) of this chapter.)

§ 178.205-34 Special box; authorized only for a polyethylene, or other suitable plastic, tight-fitting inside container having a minimum wall thickness of 0.015 inch and so designed as to maintain its configuration when standing empty and open.

(a) Box shall comply with this specification except that top of box shall be closed by means of slotted flaps so arranged as to provide protection for the neck of the inside container and be fitted with fill-in pieces as necessary; equally efficient closures and container neck protectors are authorized. Complete package, closed as for shipment with inside container filled to rated capacity with water must be capable of withstanding 2 drops from a height of 4 feet onto solid concrete without leakage or serious rupture of box. Authorized gross weight not over 65 pounds.

§ 178.205-35 Special box; authorized only for aircraft type wet electric storage batteries.

(a) Box shall comply with this specification and shall be constructed of at least 275-pound test double-faced corrugated fiberboard. Inside corrugated fiberboard cushioning shall be provided as necessary to prevent short-circuits, breakage under normal conditions of transportation, and superimposed weights on links, covers, or other parts weaker than the battery case. Not more than one wet electric storage battery shall be packed in a box and gross weight shall not exceed 85 pounds.

§ 178.205-36 Special box; authorized only for an inside polyethylene container, spec. DOT-2U (§ 178.24 of this chapter), not over 5 gallons capacity.

(a) Box shall comply with this specification except as provided herein, and shall have glued closure flaps only. Inner and outer top closure flaps may have suitably sized holes for access to the closure of the polyethylene container. The diameter of these holes must be less than the diameter of a metal plate inserted between the flaps to which polyethylene closure shall be attached.

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-21, 36 FR 18469, Sept. 15, 1971]

§ 178.205-37 Special box; authorized polyethylene or other suitable plastic bags for packaging of electrolyte (acid) or alkaline corrosive battery fluid only.

(a) Box shall comply with this specification except as follows: Box must be one-piece construction of slotted style and may have die-cut areas of minimum size to provide access to an inside closure part. Box must contain one multiwall bag made of polyethylene or other suitable plastic of sufficient size and capacity to be capable of coming into contact with all of the interior surfaces of the box when filled. Each ply of the bag must be formed from virgin film not less than 0.003 inch thick. Joints must be heat sealed and not less than ⅛-inch wide.

(b) Boxes must be center special slotted style, or regular slotted style. If any metal is used in the box construction, full liners and top and bottom pads are required. Any metal closure for a discharge tube must be installed so as to prevent contact with the polyethylene bag. Discharge tubes must be plugged or heat sealed. Maximum volumetric capacity must not exceed 5 gallons (nominal).

(1) For boxes having capacities of 6 quarts (nominal) or less, fiberboard of at least 200-pound test is required for construction.

(2) For boxes having capacities in excess of 6 quarts, fiberboard of at least 350-pound test is required. Pads are required for regular slotted style boxes and must be of fiberboard of at least 350-pound test or other material that will provide equivalent protection.

(c) Representative samples of completely assembled boxes, with all parts closed as for shipment, must be capable of withstanding the following tests without leakage or serious damage to boxes. No one box shall be expected to withstand more than one of the following tests:

(1) Box with inside container filled to shipping capacity with a solution which is compatible with the plastic bags, must be dropped twice from a height of 4 feet onto concrete, one

drop to be made with the box positioned so as to strike flat on the box bottom, the other drop to be made so box will strike flat on the largest face.

(2) Box with inside container filled to shipping capacity with a solution which is compatible with the plastic bags, and remains liquid at 0° F. or lower shall be dropped once from a height of 4 feet onto concrete, when container and contents are at or below 0° F. Box shall be positioned so as to strike flat on the box bottom.

(3) Box with inside container filled as prescribed in paragraph (c)(1) of this section shall be capable of withstanding a vibration test by placing the container on the vibration table anchored in such manner that all horizontal motion shall be restricted and only vertical motion allowed. The test shall be performed for one hour using an amplitude of one inch at a frequency that causes the test container to be raised from the floor of the table to such a degree that a piece of paper or flat steel strap or tape can be passed between the table and the container.

(d) Tests to be conducted by or for each plant assembling and filling boxes at the initial start of production and at intervals of four months thereafter. Samples last tested must be dated with date of test and must be retained until further tests are made.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-8, 34 FR 18554, Nov. 21, 1969; Amdt. 178-16, 36 FR 1534, Feb. 2, 1971; Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.206 Specification 12C; fiberboard boxes.

§ 178.206-1 Compliance.

(a) Required in all details.

§ 178.206-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box, except recessed flanged heads, are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 178.206-3 Classification of board.

(a) Fiberboard is hereby classified by strength of completed board as in first column of the following table; weights specified in the table are the minimums authorized.

Classified strength [1] of completed board	Solid fiberboard—Minimum combined weight of component plies exclusive of adhesives (pounds per 1,000 sq. ft.)	Facings for corrugated fiberboard	
		Double faced—Minimum combined weight of facings (pounds per 1,000 sq. ft.)	Double wall—Minimum combined weight of facings including center liner (pounds per 1,000 sq. ft.)
175	149	75	.....
200	190	84	92
275	237	138	110
350	283	180	126

[1] Mullen or Cady test (minimum).

§ 178.206-4 Solid fiberboard.

(a) To be 3-ply or more; both outer plies water resistant.

§ 178.206-5 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1000 square feet; all parts must be securely glued together throughout all contact areas.

§ 178.206-6 Stitching staples.

Stitching staples must be made in such a configuration that their holding capability as installed will not be less than that of flat steel staples $\frac{3}{32} \times 0.019$ inch in cross section and not less than $\frac{7}{16}$-inch wide.

[Amdt. 178-12, 35 FR 11687, July 22, 1970]

§ 178.206-7 Tape.

(a) Coated with glue at least equal to No. 1¾ Peter Cooper standard. Cloth tape of strength, across woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24×36 inches); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape, except as provided in § 178.206-11(d).

(b) Tape for closure of slotted containers complying with the following requirements is authorized when applied as prescribed in § 178.206-17(a)(2):

(1) Tape must be not less than 3 inches wide and shall be made of two sheets of 100 percent sulfate Kraft each not less than 30 pounds basis weight, reinforced with glass, sisal, or rayon fiber, combined with a laminant of asphalt or other material not affected by temperature extremes any more than would standard 180° to 200° softening point asphalt.

(2) Tape must be reinforced by lengthwise fibers spaced not more than an average of ½ inch apart, and by crosswise fibers spaced not less than an average of 2 per inch except that when a diamond pattern is employed for crosswise reinforcement, the spacing between the parallel sides of the diamond measured in the machine direction must be not more than 1 inch.

(3) Glass or sisal reinforced tape must have a minimum tensile strength in the machine direction of 75 pounds per inch of width and a minimum tensile strength in the cross direction of 45 pounds per inch of width; rayon reinforced tape must have a minimum tensile strength in the machine direction of 57 pounds per inch of width and a minimum tensile strength in the cross direction of 27 pounds per inch of width with elongation not exceeding 15 percent. Tensile tests on the finished product shall be made on a 3-inch width sample.

§ 178.206-8 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(4) For corrugated fiberboard, doublepop tests may be disregarded.

§ 178.206-9 Types authorized.

(a) To be of solid or corrugated fiberboard of the following types:

(1) Slotted box: three-piece box without recessed ends; three-piece box of solid fiberboard with recessed ends; double-slide box; triple-slide box; telescope box, with sections of equal depth or with covers, top or bottom or both, with 3-inch overlap. (See § 178.206-14 (d) for boxes with single-flap closures.)

§ 178.206-10 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 178.206-11 Joints.

(a) For solid and corrugated fiberboard slotted containers: Lapped 1½ inches from center of scoreline except as in § 178.206-12; stitched at 2½ inch intervals and within 1 inch of each end of joint; body joint must be double-stitched (2 parallel stitches) at each end of joint over 18 inches long.

(b) For corrugated fiberboard slotted containers only: One butt joint taped (See § 178.206-7) is authorized; 3 inch tape requested for boxes over 30 pounds authorized gross weight and 2 inch tape for others.

(c) For triple and double slide boxes: Joints of all slides must be taped (See § 178.206-7) or stitched.

(d) For corrugated fiberboard only: One butt joint taped inside and outside with strips of one thickness of sulphate paper not less than 2 inches wide extending entire length of joint and firmly glued to box. For boxes not exceeding 65 pounds gross weight, outside strip of sulphate paper to be of basis weight not less than 60 pounds testing not less than 60 pounds and inside strip of sulphate paper to be of basis weight not less than 40 pounds testing not less than 40 pounds. For boxes exceeding 65 pounds gross weight, outside and inside with strips of sulphate paper which must each be of basis weight not less than 90 pounds testing not less than 90 pounds. Basis weight of paper shown is 500 sheets, 24×36 inches.

(1) For glued lap joint, the sides of box forming joint must lap not less than 1¼" and be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after the film application has dried.

§ 178.206–12 Flanged heads.

(a) Must have 4 flanges, at least 1" long above fillet, on each head. Recessed flanged heads not authorized for boxes of corrugated fiberboard.

§ 178.206–13 Seams which are to be stitched.

(a) Overlap, if any, required to be at least 1½ inches from center of scoreline except as in § 178.206–12.

§ 178.206–14 Flap closures.

(a) Fill-in pieces, of the same type fiberboard as used in construction of the container, are required where it is necessary to prevent an opening between the inner flaps, unless otherwise provided by Part 173 of this chapter.

(b) If to be closed by adhesive, each inner flap must cover at least one-third of face; inner flaps must butt or have full overlap, or fill-in pieces must be used unless otherwise provided by Part 173 of this chapter, except that fill-in pieces are not required when outer flaps have full overlap. Outer flaps must be reasonably close together at the center seam or have full overlap.

(c) In lieu of fill-in pieces between inner flaps which do not butt, the following is authorized when linings are not prescribed in § 178.206–16:

(1) Top and bottom pads the same dimensions as interior of container of solid or corrugated fiberboard at least 125 pounds test (Mullen or Cady).

(2) Minimum combined weight of facings of corrugated fiberboard pads must be at least 52 pounds per thousand square feet.

(3) Minimum combined weight of component plies for solid fiberboard pads must be at least 114 pounds per thousand square feet, exclusive of adhesives.

(4) Complete inner box or boxes.

(d) Single-flap closures are authorized for boxes with one dimension not over 2"; each flap must be scored and form one of the small faces of the box and lap at least 5" on one of the largest faces.

§ 178.206–15 Linings (when prescribed).

(a) Of 1 piece to extend around 4 faces with joint at center of 1 face and with 4 flanges, at least 1½" long, on each end (corners may be mitered) to bend over the other 2 faces; also 2 pads to cover the other 2 faces. Pads may be omitted if closing flaps afford 3 thicknesses throughout face. For boxes with 1 dimension not over 3", one of the widest flanges may be lengthened to cover entire face and lap 6" on the adjoining face and the other flanges and the pads may then be omitted.

§ 178.206–16 Authorized gross weight and parts required.

(a) Authorized gross weight (when packed) and parts required as follows:

Authorized gross weight (pounds)	Strength of fiberboard (minimum) Mullen or Cady test						
	Solid board			Doublefaced corrugated		Double wall corrugated	
	Box	Lining [2]	Heads [1]	Box	Lining [2]	Box	Lining [2]
30	175		200	175		200	
40	200		275	200		200	
			350	[3] 275			
65 [4]	275			200	175	275	

[1] For recessed heads when used. In other cases same as for box.

[2] As prescribed in § 178.206-15. A complete box is acceptable in place of the lining.

[3] Facings at least 138 pounds per thousand square feet or inner facing at least 42 pounds and outer facing at least 90 pounds per thousand square feet.

[4] Except as otherwise authorized by Part 173 of this chapter.

(b) Triple slide boxes of double-faced corrugated fiberboard of at least 175-pound test are also authorized for 65 pounds gross weight.

§ 178.206-17 Closing for shipment.

(a) Slotted container, by coating with adhesive the entire contact surfaces of closing flaps and fill-in pieces where required or as prescribed in paragraph (a)(1), (2), or (3) of this section.

(1) By stitching with staples as prescribed by § 178.206-6 at 2½-inch intervals along all seams (one 5-inch space allowed when necessary to permit use of stitching device); or with staples made of flat wire of hardness not less than equivalent of Rockwell B90, and not less than 0.037 inch thick and not less than 0.074 inch wide, with not less than 1¼-inch crown, may be spaced not more than 5 inches apart. Such staples may be used across center seam where outside flaps meet in lieu of on both sides of center seam but need only be used where outside flaps overlay inner flaps; or staples made of arcuate wire of hardness not less than equivalent of Rockwell B90, and not less than 0.027 inch thick and not less than 0.095 inch wide, with not less than 1 inch crown, may be spaced not more than 5 inches apart. Such stitches when spaced not more than 2½ inches apart may be used across center seam where outside flaps meet in lieu of on both sides of center seam but need only be used where outside flaps overlap inner flaps.

(2) For fiberboard boxes containing not more than 1 inside metal can not exceeding 1 gallon nominal capacity, by application of 2 strips of pressure-sensitive tape not less than ½ inch in width, 1 strip to be placed approximately equal distance over the seam of abutting outer flaps, the other at a right angle to the first and spaced approximately equal distance on the closure face; strips must be of sufficient length to extend not less than 1 inch beyond score lines on side and end panels. Tape shall have a minimum tensile strength of 160 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width; and minimum elongation of 12 percent at break, or having a minimum longitudinal tensile strength of not less than 240 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width and a minimum elongation of 3 percent at break.

(3) For slotted containers only, reinforced tape complying with the requirements of § 178.206-7(b) is authorized for application over the center seam only. Tape must extend over the ends of box not less than 2½ inches.

(b) Double slide boxes or triple slide boxes, by coating with adhesive the inner slides: for single-flap closures as authorized for boxes with one dimension not over 2 inches, the flaps must be fastened to the body with adhesive.

(c) Fiberboard boxes with covers extending over sides but not to bottom, covers resting on walls of box, or telescope boxes of equal depth section, covers extending to bottom, must be secured by one of the following methods:

(1) By not less than three metal straps, one lengthwise and others at right angles thereto.

(2) When cover extends not less than 3 inches over the walls of the box, by coating with adhesive the entire contact area of the cover.

(d) When metal straps are specified, boxes must be strapped with the required number; size at least ⅝ inch × 0.015 inch.

§ 178.206-18 Marking.

(a) On each container. Symbol in rectangle as follows:

DOT-12C***

(1) Stars to be replaced by authorized gross weight (for example, DOT-12C65, etc.).

(2) Name and address or symbol of person making the mark specified in

paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) When metal straps are prescribed boxes must be marked "——— (number) METAL STRAPS REQUIRED" just above or below the mark specified in this paragraph.

(4) Size of markings: Specification markings prescribed in paragraph (a)(1) of this section must be at least ½ inch high; other markings must be legible.

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.206-19 Special box; authorized only for polyethylene, or other suitable plastic, tight-fitting inside containers having minimum wall thickness of 0.015 inch and so designed as to maintain their configuration when standing empty and open.

(a) Box shall comply with this specification except that top of box shall be closed by means of slotted flaps so arranged as to provide protection for the neck of the inside container and be fitted with fill-in pieces as necessary. Top may have die-cut area of suitable size to provide for easy opening. Complete package, closed as for shipment, with inside container filled to rated capacity with water, must be capable of withstanding 2 drops from a height of 4 feet onto solid concrete without leakage or serious rupture of box. Authorized gross weight not over 65 pounds. (See § 173.257(a)(6) of this chapter.)

§ 178.207 Specification 12D; fiberboard boxes.

§ 178.207-1 Compliance.

(a) Required in all details.

§ 178.207-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 178.207-3 Classification of board.

(a) Fiberboard is hereby classified by strength of completed board as in first column of the following table; weights specified in the table are the minimums authorized.

Classified strength[1] of completed board	Facings for double-wall corrugated fiberboard—Minimum combined weight of facings including center liner (pounds per 1,000 sq. ft.)
275	110
350	126

[1] Mullen or Cady test (minimum).

§ 178.207-4 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets at least 0.009" thick and weigh not less than 26 pounds per 1000 square feet; all parts securely glued together throughout all contact areas.

§ 178.207-5 Stitching staples.

Stitching staples must be made in such a configuration that their holding capability as installed will not be less than that of flat steel staples $\frac{3}{32} \times 0.019$ inch in cross section and not less than $\frac{7}{16}$-inch wide.

[Amdt. 178-12, 35 FR 11687, July 22, 1970]

§ 178.207-6 Tape.

(a) Coated with glue at least equal to No. 1$\frac{3}{4}$ Peter Cooper standard. Cloth tape of strength, across the woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24" × 36"); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape, except as provided in § 178.207-10(d).

(b) Tape for closure of slotted containers complying with the following requirements is authorized when applied as prescribed in § 178.207-17(a)(3):

(1) Tape must be not less than 3 inches wide and shall be made of two sheets of 100 percent sulfate Kraft each not less than 30 pounds basis weight, reinforced with glass, sisal, or rayon fiber combined with a laminant of asphalt or other material not affected by temperature extremes any more than would standard 180° to 200° softening point asphalt.

(2) Tape must be reinforced by lengthwise fibers spaced not more than an average of ½ inch apart, and by crosswise fibers spaced not less than an average of 2 per inch except that when a diamond pattern is employed for crosswise reinforcement, the spacing between the parallel sides of the diamond measured in the machine direction must be not more than 1 inch.

(3) Glass or sisal reinforced tape must have a minimum tensile strength in the machine direction of 75 pounds per inch of width and a minimum tensile strength in the cross direction of 45 pounds per inch of width; rayon reinforced tape must have a minimum tensile strength in the machine direction of 57 pounds per inch of width, and a minimum tensile strength in the cross direction of 27 pounds per inch of width with elongation not exceeding 15 percent. Tensile tests on the finished product shall be made on a 3-inch width sample.

§ 178.207-7 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures 12 from each side, when all results but 4 show prescribed strength the board is acceptable.

(4) Double-pop tests may be disregarded.

§ 178.207-8 Types authorized.

(a) To be of double-wall corrugated fiberboard of the following types:

(1) Slotted box; three piece box without recessed ends; double-slide box; triple-slide box; telescope box, with sections of equal depth, or with covers, top or bottom or both, with 3 inch overlap.

§ 178.207-9 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 178.207-10 Joints.

(a) For slotted container: Lapped 1½ inches from center of scoreline except as in § 178.207-11; stitched at 2½-inch intervals and within 1 inch of each end of joint; body joint must be double-stitched (2 parallel stitches) at each end of joint over 18 inches long.

(b) For slotted containers only: One butt joint taped (See § 178.207-6) is authorized; 3 inch tape required.

(c) For triple and double slide boxes: Joints of all slides must be taped (See § 178.207-6) or stitched.

(d) One butt joint taped inside and outside with strips of one thickness of sulphate paper not less than 2 inches wide extending entire length of joint and firmly glued to box. For boxes not exceeding 65 pounds gross weight, outside strip of sulphate paper to be of basis weight not less than 60 pounds testing not less than 60 pounds and inside strip of sulphate paper to be of basis weight not less than 40 pounds testing, not less than 40 pounds. For boxes exceeding 65 pound gross weight, outside and inside with strips of sulphate paper which must each be of basis weight not less than 90 pounds testing not less than 90 pounds. Basis weight of paper shown is for 500 sheets, 24 × 36 inches.

(1) For glued lap joint, the sides of box forming joint must lap not less than 1¼" and be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved

in water after the film application has dried.

§ 178.207-11 Flanged heads.

(a) Must have 4 flanges, at least 1" long above fillet, on each head. Recessed flanged heads not authorized.

§ 178.207-12 Seams which are to be stitched.

(a) Overlap, if any, required to be at least 1½ inches from center of scoreline except as in § 178.207-11.

§ 178.207-13 Flap closures.

(a) Fill-in pieces, of the same type fiberboard as used in construction of the container, are required where it is necessary to prevent an opening between the inner flaps.

(b) If to be closed by adhesive, each inner flap must cover at least ⅓ of face, inner flaps must butt or have full overlap, or fill-in pieces must be used; except that fill in pieces are not required when outer flaps have full overlap. Outer flaps must butt or have full overlap.

§ 178.207-14 Linings (when prescribed).

(a) Of 1 piece to extend around 4 faces with joint at center of 1 face and with 4 flanges, at least 1½" long, on each end (corners may be mitered) to bend over the other 2 faces; also 2 pads to cover the other 2 faces. Pads may be omitted if closing flaps afford 3 thicknesses throughout face. For boxes with 1 dimension not over 3", one of the widest flanges may be lengthened to cover entire face and lap 6" on the adjoining face and the other flanges and the pads may then be omitted.

§ 178.207-15 Authorized gross weight and parts required.

(a) Authorized gross weight (when packed) and parts required as follows:

(1) For authorized gross weight not over 25 pounds, box must be constructed of at least 275-pound test double-wall corrugated fiberboard with liners and top and bottom pads, or a complete inner box, of same material.

(2) For authorized gross weight over 25 pounds but not exceeding 75 pounds, inside containers must be packed in boxes of at least 275-pound test double-wall corrugated fiberboard and these packages packed in an outside box of at least 350-pound test double-wall corrugated fiberboard.

§ 178.207-16 Test for completed package.

(a) The completed packages closed as for shipment must be capable of withstanding a drop of 4 feet to solid concrete without breakage of the inside containers.

§ 178.207-17 Closing for shipment.

(a) Slotted container, by coating with adhesive the entire contact surfaces of closing flaps and fill-in pieces, or as prescribed in paragraphs (a) (1), (2), or (3) of this section.

(1) By stitching at 2½-inch intervals along all seams (one 5-inch space allowed when necessary to permit use of stitching device).

(2) For fiberboard boxes containing not more than 1 inside metal can not exceeding 1 gallon nominal capacity, by application of 2 strips of pressure-sensitive tape not less than ½ inch in width, 1 strip to be placed approximately equal distance over the seam of abutting outer flaps, the other at a right angle to the first and spaced approximately equal distance on the closure face; strips must be of sufficient length to extend not less than 1 inch beyond score lines on side and end panels. Tape shall have a minimum tensile strength of 160 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width; and minimum elongation of 12 percent at break, or having a minimum longitudinal tensile strength of not less than 240 pounds per inch of width; minimum adhesion value of 18 ounces per inch of width and a minimum elongation of 3 percent at break.

(3) For slotted containers only, reinforced tape complying with the requirements of § 178.207-6(b) is authorized for application over the center seam only. Tape must extend over the ends of box not less than 2½ inches.

(b) Double slide boxes or triple slide boxes, by coating with adhesive the inner slides; for single-flap closures as authorized for boxes with one dimension not over 2 inches, the flaps must be fastened to the body with adhesive.

(c) Fiberboard boxes with covers extending over sides but not to bottom, covers resting on walls of box, or telescope boxes of equal depth section, covers extending to bottom, must be secured by one of the following methods:

(1) By not less than three metal straps, one lengthwise and others at right angles thereto.

(2) When cover extends not less than 3 inches over the walls of the box, by coating with adhesive the entire contact area of the cover.

(d) When metal straps are specified, boxes must be strapped with the required number; size at least ⅝ inch by 0.015 inch.

§ 178.207-18 Marking.

(a) On each container. Symbol in rectangle as follows:

DOT-12D***

(1) Stars to be replaced by authorized gross weight (for example, DOT-12D65, etc.).

(2) Name and address or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) When metal straps are prescribed, boxes must be marked "———(number) METAL STRAPS REQUIRED" just above or below the mark specified in this paragraph.

(4) Size of markings: Specification markings prescribed in paragraph (a)(1) of this section must be at least ½ inch high; other markings must be legible.

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.208 Specification 12E; fiberboard boxes.

§ 178.208-1 Compliance.

(a) Required in all details.

§ 178.208-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box, except recessed flanged heads, are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 178.208-3 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1,000 square feet; all parts must be securely glued together throughout all contact areas.

§ 178.208-4 Tape.

(a) Coated with glue at least equal to No. 1¾ Peter Cooper standard. Cloth tape of strength, across woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24 × 36 inches); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape.

§ 178.208-5 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(4) Double-pop tests may be disregarded.

§ 178.208-6 Type authorized.

(a) Corrugated fiberboard with one-piece body with separate flanged heads. Box is authorized only for 1 or 2 rectangular metal inside containers of not over 5 gallons capacity each.

§ 178.208-7 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 178.208-8 Joints.

(a) *Body.* Each end of body must have four flanges, creased to bend over outside of body, at least 2½" long beyond crease.

(b) *Butt joint.* One butt joint taped is authorized; 3-inch tape required.

§ 178.208-9 Flanged heads.

(a) Each head must have four flanges, one on each edge, creased to bend over outside body of the box and then under the body flanges, of length at least 5 inches exclusive of creases.

§ 178.208-10 Authorized gross weight (when packed) and parts required.

(a) Board for outside container must be corrugated fiberboard at least 400-pound test; minimum combined weight of component plies, exclusive of adhesives, 180 pounds per 1,000 square feet; body must be double-wall board; heads may be double-faced board. Authorized gross weight 110 pounds.

§ 178.208-11 Closing for shipment.

(a) Boxes must be closed by applying heads with head-flanges tucked under body-flanges and then fastening each head in place with a flat steel strap, at least ⅜" × 0.015", extending around the 4 sides of the body and securely sealed.

§ 178.208-12 Marking.

(a) Each box must be marked as follows:

(1) DOT-12E110.

(i) This marking shall be enclosed by a rectangle.

(2) Name and address or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) When metal straps are prescribed, boxes must be marked "——— (number) METAL STRAPS REQUIRED" just above or below the mark specified in paragraph (a)(1) of this section.

(4) Size of markings: Specification markings specified in paragraph (a)(1) of this section must be at least ½ inch high. All markings must be legible.

[Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.209 Specification 12H; fiberboard boxes.

§ 178.209-1 Compliance.

(a) Required in all details.

§ 178.209-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 178.209-3 Classification of board.

(a) Fiberboard is hereby classified by strength of completed board as in first column of the following table; weights specified in the table are the minimum authorized.

Classified strength [1] of completed board	Facings for corrugated fiberboard	
	Double-faced minimum combined weight of facings (pounds per 1,000 sq. ft.)	Double-wall minimum combined weight of facings including center liner (pounds per 1,000 sq. ft.)
275	138	110
325	138	110
350	180	126
375	180	180
400	180	180
450	180	180

[1] Mullen or Cady test (minimum).

§ 178.209-4 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1000 square feet; all parts must be securely glued together throughout all contact areas.

§ 178.209-5 Stitching staples.

Stitching staples must be made in such a configuration that their holding capability as installed will not be less than that of flat steel staples 3/32 × 0.019 inch in cross section and not less than 7/16-inch wide. Materials used must be at least equivalent to copper coated steel in nonsparking quality.

[Amdt. 178-12, 35 FR 11687, July 22, 1970]

§ 178.209-6 Tape.

(a) Used for manufacturers' joints must be coated with glue at least equal to No. 1¾ Peter Cooper standard. Cloth tape of strength, across the woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24" × 36"); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape.

§ 178.209-7 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be restested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength, the board is acceptable.

(4) For corrugated fiberboard, double-pop tests may be disregarded.

§ 178.209-8 Type authorized.

(a) Shall be corrugated fiberboard, telescoping type, 1-piece, 2-piece, or 3-piece construction without recessed heads, as follows:

(1) Box to consist of top and bottom sections divided equally or unequally and inner lining tube. The lining tube must be staple stitched to the lower section of the box to give in effect a 2-piece box. (See § 178.209-11.)

(2) Box to consist of full depth top and bottom sections completely telescoping. No inner lining tube required. Three variations are authorized: one with bottom slotted on ends and cover on sides; second, with both cover and bottom slotted on sides; and third, with sides and ends (both covers and bottom) not slotted, manufacturer's joint a side lap glued or stapled to end, closing flaps to form top and bottom of box with side closing flaps out and overlapping.

NOTE 1: Hand-holes oval in shape, not more than 1 inch in width by 3 inches in length, and horizontal with top score line, are authorized in ends of top section of boxes.

(3) Box to consist of 1-piece, 2-piece, or 3-piece, without recessed heads, fitted with lining tube as prescribed in § 178.209-11, except that lining tube is not required for boxes used for shipment of electric blasting caps packed in accordance with § 173.66(g)(1) of this chapter. When outer flaps butt, inner flaps must also butt, except 1-piece with tube or 2-piece fully telescoping ½ slotted style may have outer flaps that overlap a minimum of 2 inches to and including full overlap, and inner flaps may be of same length as outer flaps.

(4) Three-piece box without recessed ends. Outer flap may be full lap style with a 3-inch or longer tuck. With the full lap style, the inner end flaps must have a minimum length of 4 inches with or without hand holes.

[29 FR 18951, Dec. 29, 1964, as amended by Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.209-9 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 178.209-10 Joints.

(a) Lapped 1½" and stitched at 2½" intervals and within 1" of each end of joint; except for full depth telescope style boxes, body joints must be double-stitched (two parallel rows of stitches).

(b) For glued lap joint, the sides of box forming joint must lap not less than 1¼" and be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after the film application has dried.

(c) For lining tubes only, one butt joint taped (see § 178.209-6) tape not less than 3" wide is authorized.

§ 178.209-11 Authorized gross weight and parts required.

(a) Box shall be corrugated fiberboard at least 275 pound test. Tubes, when required, shall be of solid fiberboard at least 200-pound test, or of corrugated fiberboard of at least 275-pound test, with adjoining edges stitched, taped, or glued.

(b) Authorized gross weight: 65 pounds; boxes may have gross weight of 103 pounds when authorized by § 173.66 (g)(1) of this chapter.

[29 FR 18951, Dec. 29, 1964, as amended by Order 71, 31 FR 9081, July 1, 1966: Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.209-12 Closing for shipment.

(a) By any method capable of withstanding tests prescribed by § 178.209-16 without failure.

§ 178.209-13 Marking.

(a) On each container. Symbol in rectangle as follows:

DOT-12H**

(1) Stars to be replaced by authorized gross weight (for example DOT-12H65).

(2) Name and address or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) Size of markings: Specification markings prescribed in paragraph (a)(1) of this section must be at least ½ inch high; other markings must be legible.

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.209-14 Special tests.

(a) *By whom and when.* By or for each plant making the boxes; at beginning of manufacture and at six-month intervals thereafter; on largest size, by weight. Smaller sizes need not be tested if they have the same or equivalent construction. Report of results, with all pertinent data, to be maintained on file for one year; copy to be filed with the Associate Director for OE.

§ 178.209-15 Material.

(a) Box material must comply with requirements of §§ 178.209-3, 178.209-4, 178.209-7, 178.209-11, and the following:

(b) Box material must have test strength and moisture content not over 30 percent as follows:

(1) Box material must test at least 200 pounds per square inch immediately after exposure for 3 days to 90 percent relative humidity at not less than 70° nor more than 75° F.

(2) Box material must test at least 100 pounds per square inch immediately after it has been in contact with water for 3 hours under 3" head at not less than 70° nor more than 75° F.

NOTE: The test shall be conducted on a sample no greater than 6 inches in diameter when exposed to water. The sample shall be rigidly fastened to a water column device so constructed as to provide at least a 3-inch head of water on the outer surface of the fiberboard sample. The water column device must be suspended in such manner that free circulation of air on the inner surface of fiberboard sample which is not exposed to water is permitted. After contact with water for 3 hours under conditions specified, the water column device shall be emptied, the sample blotted, and immediately subjected to Mullen or Cady test. (A 6-inch diameter pipe having a welded flange to which the sample is secured by a bolted ring flange is acceptable.)

[29 FR 18951, Dec. 29, 1964, as amended by Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.209-16 Completed container.

(a) Samples must pass the following immediately after exposure for 2 weeks to 90 percent relative humidity at not less than 70° nor more than 75° F., loaded containers shall contain dummy contents of shape and weight of the expected contents, and shall be closed in the same manner as for shipment:

(1) Three loaded samples to be tested. Each must withstand 200 drops in standard 7-foot revolving test drum with pointed hazard in place, without spilling any contents.

(2) Three loaded samples to be tested. Each must withstand end to end pressure of at least 500 pounds without deflection of over 1½ inches.

(3) Three empty samples to be tested. Each must withstand top to bottom pressure of at least 500 pounds without deflection of over ½ inch.

(b) As an alternate to the drum test specified in paragraph (a) of this section, 3 loaded samples must pass the drop test specified below:

(1) Box shall be dropped from height of 2 feet.

(2) Identification of face, edge, and corners. Facing one end (with the manufacturer's joint on the observer's right), the top of the box is designated as 1, the right side as 2, the bottom as 3, and the left side as 4. The near end is designated as 5 and the far end as 6. The edges are identified by the number of the two faces which make that edge, as for example, 1-2 identifies the edge where the top and right side meet and 2-5 the edge having the manufacturer's joint. The corners are identified by the number of the three faces which meet to form that corner, as for example, 1-2-5 identifies the corner where the top, the right side, and the near end meet.

(c) Drop sequence as follows:

(1) A corner drop on 1-2-5.

(2) An edge drop on the shortest edge radiating from that corner (usually 2-5).

(3) An edge drop on the next shortest edge radiating from that corner (usually 1-5).

(4) An edge drop on the longest edge radiating from that corner (usually- 1-2).

(5) A flatwise drop on one of the smallest faces (usually end 5 or 6).

(6) A flatwise drop on the opposite smallest face.

(7) A flatwise drop on one of the medium faces (usually side 2 or 4).

(8) A flatwise drop on the opposite medium face.

(9) A flatwise drop on one of the largest faces (usually top 1 or bottom 3).

(10) A flatwise drop on the opposite large face.

This completes one cycle of ten drops. Commence the next cycle, with a drop on the corner diagonally opposite through the box to the corner on which the first drop was made, on corner 3-4-6. Commence the third cycle of ten drops with corner 1-4-5. Each loaded container must withstand 3 cycles without spilling or sifting of contents.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.210 Specification 12A; fiberboard boxes.

Nonreuseable containers.

§ 178.210-1 Compliance.

(a) Required in all details.

§ 178.210-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box, except recessed flanged heads, are connected together in setting up the box. Generally done by box maker.

§ 178.210-3 Classification of board.

(a) Fiberboard is hereby classified by strength[1] of completed board as in first column of the following table; weights specified in the table are the minimums authorized.

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[1] Mullen or Cady test (minimum).

Classified strength[1] of completed board	Facings for corrugated fiberboard	
	Double-faced minimum combined weight of facings (pounds per 1,000 sq. ft.)	Double-wall minimum combined weight of facings including center liner (pounds per 1,000 sq. ft.)
200	84	92
275	138	110

[1] Mullen or Cady test (minimum).

§ 178.210-4 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets must be at least 0.009 inch thick and weigh not less than 26 pounds per 1000 square feet; all parts must be securely glued together throughout all contact areas.

§ 178.210-5 Tests.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity), under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side, when all results but 4 show prescribed strength the board is acceptable.

(4) Double-pop tests may be disregarded.

§ 178.210-6 Boxes authorized.

(a) Corrugated fiberboard boxes having gross weight not over 80 pounds of the following strengths are authorized

Gross weight not over (pounds)	Corrugated fiberboard strength (Mullen or Cady test) minimum	
	Double-faced	Double-wall
20	200	200
50	275	200
80		275

§ 178.210-7 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 178.210-8 Joints.

(a) For slotted containers: Lapped 1½ inches from center of scoreline except as in § 178.210-8(b)(2); stitched at 2½-inch intervals and within 1 inch of each end of joint; body joint must be double-stitched (2 parallel stitches) at each end of joint over 18 inches long.

(b) Joints as provided for by the following are authorized provided resulting joint is capable of withstanding the tests prescribed by § 178.210-10:

(1) For slotted containers only; one butt joint, taped, is authorized.

(2) For glued lap joint, the sides of box forming joint must lap not less than 1¼ inches and be firmly glued throughout entire area of contact with a glue of adhesive which cannot be dissolved in water after the film application has dried.

(3) For triple and double slide boxes, joints of all slides must be taped or stitched.

§ 178.210-9 Inside cushioning.

(a) Sufficient inside cushioning shall be required for protection of inside containers so that completed packages as offered for shipment shall be capable of withstanding test prescribed by § 178.210-10.

§ 178.210-10 Test for completed package.

(a) A minimum of 4 boxes with inside containers filled with water, and box closed as for shipment, shall be capable of withstanding the following drop tests from the prescribed heights onto solid concrete without leakage from or breakage of any inside container or rupture of the outside fiberboard box; each box shall be subjected to not more than one of the series of tests:

(1) Box No. 1. Flat drop on bottom from height of 4 feet.

(2) Box No. 2. Flat drop on side from height of 4 feet.

(3) Box No. 3. Flat drop on end from height of 4 feet.

(4) Box No. 4. Flat drop on top from height of 2 feet.

(b) Tests prescribed by paragraph (a) of this section must be conducted prior to initial use of the package and shall be repeated on the change of any components of the package.

§ 178.210-11 Closing for shipment.

(a) By any method capable of withstanding tests prescribed by § 178.210-10.

§ 178.210-12 Marking.

(a) On each container. Symbol in rectangle as follows:

DOT-12**

(1) Stars to be replaced by authorized gross weight (for example, DOT-12A75). The letters NRC, located just above or below the DOT mark, to indicate a nonreuseable container.

(2) Name and address or symbol of person making the marks specified in paragraph (a)(1) of this section and located just above or below those marks. Symbol, if used, must be registered with the Associate Director for OE.

(3) Size of markings: Specification markings prescribed in paragraph (a)(1) of this section must be at least ½ inch high; other markings must be legible.

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.211 Specification 12P; fiberboard boxes. Nonreuseable containers for inside plastic containers greater than 1-gallon capacity, as prescribed in Part 173 of this subchapter.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 App. A to Part 1, and paragraph (a)(4) App. A to Part 106)

[Amdt. 178-61, 45 FR 46423, July 10, 1980]

§ 178.211-1 Material requirements.

(a) Boxes shall be of corrugated fiberboard, except as otherwise authorized in this specification, having both outer facings water resistant; corrugating medium shall be at least 0.009 inch thick and weigh not less than 26 pounds per 1,000 square feet; all parts shall be securely glued together throughout all contact areas.

(b) Solid fiberboard is authorized when of strength equal to corrugated fiberboard and in conformance with paragraph (c) of this section.

(c) Fiberboard required and tests as follows:

(1) Fiberboard is hereby classified by strength[1] of completed board as in first column of the following table; weights specified in the table are the minimums authorized.

(2) Tests of acceptable completed board must have prescribed strength, Mullen or Cady test, after exposure for at least 3 hours to normal atmospheric conditions (50 to 70 percent relative humidity) under test, as follows:

Classified strength of completed board [1]	Solid fiberboard—minimum combined weight of component plies exclusive of adhesives (pounds per 1,000 sq. ft.)	Single-wall—minimum combined weight of facings (pounds per 1,000 sq. ft.)	Double-wall—minimum combined weight of facings including center facings (pounds per 1,000 sq. ft.)
175	149	75	
200	190	84	92
275	237	138	110
325	237	138	110
350	283	180	126
375	283	180	180
400	283	180	180
450	283	180	180
500	330		222

[1] Mullen or Cady Test (minimum).

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[1] Mullen or Cady Test (minimum).

(i) Clamp board firmly in machine and turn wheel at constant speed of approximately 2 revolutions per second.

(ii) Six bursts required, 3 from each side; all results but one must show prescribed strength.

(iii) Board failing may be retested by making 24 bursts, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(iv) For corrugated fiberboard, double-pop tests may be disregarded.

§ 178.211-2 Construction requirements.

(a) Corrugated or solid fiberboard boxes of any type capable of withstanding tests prescribed by § 178.211-5 authorized when constructed in accordance with requirements of this section.

(b) Corrugated or solid fiberboard boxes in accordance with the following table are authorized.

Gross weight not over (pounds)	Strength of fiberboard (minimum) Mullen or Cady test		
	Solid board	Single-wall corrugated	Double-wall corrugated
20	200	200	200
60	350	350	275
80	500	450	350

(c) All parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding. Box must provide snug fit for inside plastic container.

(d) Joints (manufacturer's). The joint is defined as that part of the box where the ends of the sheet are joined together by taping, stitching or gluing.

(1) For glued or stitched lap joint, the sides of box forming joint must lap not less than 1¼ inches. Glued joints must be firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after film application has dried.

(2) Butt-joints, taped, are authorized providing resulting joints are capable of withstanding tests prescribed by § 178.211-5.

§ 178.211-3 Design limitations.

(a) Design limitations are as follows:

(1) Permitted when perforated or die-cut areas remain intact following tests prescribed for box by § 178.211-5.

(i) Outer closing flaps may have perforated areas of no greater size than is necessary to provide access to closure of plastic container; inner flaps may have die-cut areas of similar type.

(ii) Die-cut holes in outer and inner closing flaps when closure for plastic container is attached to a metal plate inserted between the inner and outer flaps or when closure area is protected by means of a plug-in or screw cap or similar device. The diameter of these holes shall be less than the diameter of the metal plate.

(iii) Inside facing of fiberboard closure flaps may be cut or perforated for opening. A tear strip may be incorporated in the body wall of fiberboard boxes provided it is above the shoulder area of the plastic container and this may be accompanied by a nominal thumb-notch in the manufacturer's joint or in a side panel of the box.

(iv) Handholes, by perforation or other means, in any part of the box providing the face having the handhole is backed up by a fiberboard sheet of equal strength of box in full height and width of that face or that handholes are above the neck area of the plastic container. No more than one handhole in any face nor more than two per box.

(v) Other perforated or die cut areas of a size and location may be used when approved by the Associated Director for OE.

(2) Not permitted:

(i) Stitched manufacturer's joint or stitched closures when any such stitch (staple) is in direct contact with the inside plastic container.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.211-4 Closure.

(a) Closure of any type is authorized provided representative boxes are capable of withstanding tests prescribed by § 178.211-5.

§ 178.211-5 Tests.

(a) Representative samples of the completed composite container assembled, filled and closed as for use must be capable of withstanding tests prescribed in the specification for the inside plastic container without rupture of the fiberboard boxes that produces a condition of the box that could result in potential damage to the inside container.

§ 178.211-6 Marking.

(a) On each container. Symbol in rectangles as follows:

DOT-12P**

(1) Stars to be replaced by authorized gross weight for which box was constructed (for example, DOT-12P80). The letters NRC, located just above or below the DOT mark, to indicate a nonreusable container.

(2) Name and address or symbol of person making the marks specified in paragraph (a)(1) of this section and located just above or below those marks. Symbol, if used, must be registered with the Associate Director for OE.

(3) Size of markings: Specification as prescribed in paragraph (a)(1) of this section must be at least ½ inch high; other marks must be legible.

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.212 Specification 12R; paperfaced expanded polystyrene board boxes. Nonreusable containers.

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.212-1 Material requirements.

(a) The board shall consist of completely fused closed cell expanded polystyrene with tightly adhered natural kraft paper facings for which detailed requirements are as follows:

(1) Basis weight of each facing, minimum 42 pounds per 1,000 square feet (Basis weight of combined facings, minimum, 84 pounds per 1,000 square feet.)

(2) Basis weight of board, minimum, 123 pounds per 1,000 square feet.

(3) Thickness of board, minimum, 0.21 inch.

(4) Moisture absorption, maximum, 25 grams weight gain per square foot with sample completely immersed in water. For 1 hour sample to be preconditioned to a constant weight at least 73° F. and 50 percent relative humidity prior to immersion.

(5) Adhesion of facings; no delamination after 24 hours with sample completely immersed in water. Sample shall be not less than 1 square foot.

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.212-2 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely in position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.212-3 Joints.

(a) *Definition.* The seam where the two edges of the box blank are joined by the box manufacturer.

(b) The joints shall be made by precrushing the lap area of the board to a minimum combined thickness of 0.28 inch, and then securing by either stitching or gluing as follows:

(1) By lapping 1½ inches from center of score line and stitching at 2½ inch intervals and within 1 inch of each end joint; body joint over 18 inches long must be double stitched (two parallel stitches) at each end of joint.

(2) By lapping 1½ inches from center of score line and firm gluing throughout entire area of contact with an adhesive which cannot be dissolved in water after the adhesive applied has dried.

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.212-4 Inside cushioning.

(a) Sufficient inside cushioning shall be required for protection of inside containers so that completed package as offered for shipment shall be capable of withstanding test prescribed by § 178.212-6.

(b) The cushioning shall be either paper-faced expanded polystyrene board meeting the requirements of § 178.212-1 or equally efficient preformed completely fused closed cell expanded polystyrene.

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.212-5 Gross weight authorized.

(a) Seventy-five pounds maximum.

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.212-6 Tests for completed package.

(a) A minimum of four boxes with inside containers filled with water, and box closed as for shipment shall be capable of withstanding either of the following tests without leakage from or breakage of any inside container or rupture of the outside containers:

(1) Drop test onto solid concrete: each box should be subjected to not more than one of the series of tests:

Box No. 1—Flat drop on bottom from height of 4 feet.

Box No. 2—Flat drop on side from height of 4 feet.

Box No. 3—Flat drop on end from height of 4 feet.

Box No. 4—Flat drop on top from height of 2 feet.

(2) Swing test on boxed glass swing test apparatus as prescribed by spec. 1A (§ 178.1); each box shall be swung from 75 inches distance once on each of the six faces.

(b) Tests prescribed by paragraph (a) of this section must be conducted prior to initial use of the package and shall be repeated on the change of any components of the package.

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.212-7 Closing for shipment.

(a) By any method capable of withstanding tests prescribed by § 178.212-6.

[Order 66, 30 FR 5757, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.212-8 Markings.

(a) On each container. Symbol in rectangle as follows:

DOT—12R**

(1) Stars to be replaced by authorized gross weight (for example, DOT-12R75). The letters NRC, located just above or below the DOT mark, to indicate a nonreusable container.

(2) Name or symbol of person making the other marks specified in this section and located on the same face as those other marks. Symbol, if used, must be registered with the Associate Director for OE.

(3) Size of markings. Specification markings prescribed in paragraph (a)(1) of this subsection must be at least one-half inch high; other markings must be legible.

[Order 66, 30 FR 5758, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.214 Specification 23F; fiberboard boxes.

§ 178.214-1 Compliance.

(a) Required in all details.

§ 178.214-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box are connected together in setting up the box. Generally done by box maker.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 178.214-3 Solid fiberboard.

(a) To be 3-ply or more; both outer plies waterproofed.

§ 178.214-4 Corrugated fiberboard.

(a) Both outer facings water resistant; corrugated sheets at least 0.009" thick; all parts securely glued together throughout all contact areas; minimum combined weight of facings not less than 84 pounds per 1,000 square feet, except when only one lining tube is used as provided by § 178.214-15(b), minimum combined weight of facings must be not less than 138 pounds per 1,000 square feet.

§ 178.214-5 Stitching staples.

Stitching staples must be made in such a configuration that their holding capability as installed will not be less than that of flat steel staples 3/32 × 0.019 inch in cross section and not less than 7/16-inch wide. Material used must be at least equivalent to copper coated steel in nonsparking quality.

[Amdt. 178-12, 35 FR 11687, July 22, 1970]

§ 178.214-6 Tape.

(a) Coated with glue at least equal to No. 1¾ Peter Cooper standard. Cloth tape of strength, across the woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (500 sheets, 24″ × 36″); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape.

§ 178.214-7 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

(4) For corrugated fiberboard, double-pop tests may be disregarded.

§ 178.214-8 Type authorized.

(a) Of solid fiberboard; 1-piece, or 3-piece without recessed heads, fitted with lining tube or lining tubes as prescribed in § 178.214-15, except that lining tubes are not required for boxes used for shipments of high explosives packed in accordance with § 173.63(a)(3) of this chapter or electric blasting caps packed in accordance with § 173.66(g)(1) of this chapter, or when box is constructed of 1-piece of not less than 600-pound test board weighing not less than 300 pounds per 1,000 square feet. Boxes having handholes may be used when approved by the Associate Director for OE.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66202, Nov. 19, 1979]

§ 178.214-9 Inside packing and size limits.

(a) As prescribed in § 178.214-15.

§ 178.214-10 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 178.214-11 Joints.

(a) Lapped 1½ inches from center of scoreline except as in § 178.214-12; stitched at 2½-inch intervals and within 1 inch of each end of joint; double-stitched (2 parallel stitches) at each end of joint over 18 inches long; or lapped not less than 1¼ inches and firmly glued throughout entire area of contact with a glue or adhesive which cannot be dissolved in water after the film application has dried.

§ 178.214-12 Flanged heads.

(a) Must have 4 flanges at least 1″ long above fillet, on each head. Recessed flanged heads not authorized.

§ 178.214-13 Seams which are to be stitched.

(a) Overlap, if any, required to be at least 1½ inches from center of scoreline except as in § 178.214-12.

§ 178.214-14 Flap closures.

(a) Flaps must butt or have full overlap excepting that inner flaps may overlap ½ inch.

§ 178.214-15 Authorized gross weight (when packed) and parts required.

(a) Box to be of solid fiberboard, special waterproofed, at least 300-pound test, and weighing at least 250 pounds per thousand square feet. Tubes to be of solid or corrugated fiberboard at least 200-pound test and of 1-piece, or as provided in paragraph (a)(1) of this section, with adjoining edges stitched, taped, or glued. Glued or stitched lap not less than 1¼". Lap must be firmly glued throughout entire area of contact with glue or adhesive which cannot be dissolved in water after the film application has dried.

(1) Or, box shall have one tube liner of solid fiberboard weighing at least 283 pounds per 1,000 square feet with joint or joints either stitched or glued as prescribed in paragraph (a) of this section. One end of the tube may have a handhole approximately ¾" deep located at the center of the top and a perforation with a minimum of ⅛" cuts and ⅛" webs extending from the handhole to the bottom.

(b) Authorized gross weight; 65 pounds when 2 or more lining tubes are used to divide the box into 2 or more compartments; 65 pounds when 1 or more lining tubes are used and contents will consist of 1 cartridge only or of black powder in bags; 65 pounds when boxes without lining tubes are used for shipments of high explosives packed in accordance with § 173.63(a)(3) of this chapter or electric blasting caps packed in accordance with § 173.66(g)(1) of this chapter; 35 pounds in all other cases except that boxes having a single solid fiberboard lining tube, the fiberboard weighing at least 283 pounds per 1,000 square feet, or corrugated fiberboard lining tube as prescribed in § 178.214-4(a), are authorized for 65 pounds gross weight.

§ 178.214-16 Closing for shipment.

(a) By any method capable of withstanding tests prescribed by § 178.214-20 without failure.

§ 178.214-17 Marking.

(a) On each container. Symbol in rectangle as follows:

DOT-23F * * *

(1) Stars to be replaced by authorized gross weight (for example, DOT-23F35 or DOT-23F65).

(2) Name and address or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) Size of markings: Specification markings prescribed in paragraph (a)(1) of this section must be at least ½ inch high; other markings must be legible.

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.214-18 Special tests.

(a) *By whom and when.* By or for each plant making the boxes; at beginning of manufacture and at six-month intervals thereafter; on largest size, by weight. Smaller sizes need not be tested if they have the same or equivalent construction. Report of results, with all pertinent data, to be maintained on file for one year; copy to be filed with the Associate Director for OE.

§ 178.214-19 Material.

(a) Box material (special waterproofed board) must be 300-pound test board and weigh at least 250 pounds per thousand square feet when commercially dry.

(b) Box material must also have 200-pound test strength and moisture content not over 30 percent as follows:

(1) Immediately after exposure for 3 days to 90 percent humidity at 75° F.

(2) Immediately after it has been in contact with water for 3 hours under 3" head at 75° F.

NOTE: The test shall be conducted on a sample no greater than 6 inches in diameter when exposed to water. The sample shall be rigidly fastened to a water column device so constructed as to provide at least a 3-inch head of water on the outer surface of the fiberboard sample. The water column device must be suspended in such manner that free circulation of air on the inner surface of fiberboard sample which is not exposed to water is permitted. After contact with water for 3 hours under conditions specified, the water column device shall be emptied, the sample blotted, and immediately subjected to Mullen or Cady test. (A 6-inch diameter pipe having a welded flange to which the sample is secured by a bolted ring flange is acceptable.)

§ 178.214-20 Completed containers.

(a) Samples must pass the following immediately after exposure for 2 weeks to 90 percent humidity at 75° F.; loaded containers shall contain dummy contents of shape and weight of the expected contents, and shall be closed in same manner as for shipment:

(1) Three loaded samples to be tested. Each must withstand 200 drops in standard 7-foot revolving test drum with pointed hazard in place without spilling any contents.

(2) Three loaded samples to be tested. Each must withstand end to end pressure of at least 500 pounds without deflection of over 1½".

(3) Three empty samples to be tested. Each must withstand top to bottom pressure of at least 500 pounds without deflection of over ½ inch.

(b) As an alternate to the drum test specified in paragraph (a) of this section, 3 loaded samples must pass the drop test specified below:

(1) Box shall be dropped from height of 2 feet.

(2) Identification of face, edge, and corners. Facing one end (with the manufacturer's joint on the observer's right), the top of the box is designated as 1, the right side as 2, the bottom as 3, and the left side as 4. The near end is designated as 5 and the far end as 6. The edges are identified by the number of the two faces which make that edge, as for example, 1-2 identifies the edge where the top and right side meet and 2-5 the edge having the manufacturer's joint. The corners are identified by the number of the three faces which meet to form that corner, as for example, 1-2-5 identifies the corner where the top, the right side, and the near end meet.

(c) Drop sequence as follows:

(1) A corner drop on 1-2-5.

(2) An edge drop on the shortest edge radiating from that corner (usually 2-5).

(3) An edge drop on the next shortest edge radiating from that corner (usually 1-5).

(4) An edge drop on the longest edge radiating from that corner (usually 1-2).

(5) A flatwise drop on one of the smallest faces (usually end 5 or 6).

(6) A flatwise drop on the opposite smallest face.

(7) A flatwise drop on one of the medium faces (usually side 2 or 4).

(8) A flatwise drop on the opposite medium face.

(9) A flatwise drop on one of the largest faces (usually top 1 or bottom 3).

(10) A flatwise drop on the opposite large face.

(d) This completes one cycle of ten drops. Commence the next cycle with a drop on the corner diagonally opposite through the box to the corner on which the first drop was made, on corner 3-4-6. Commence the third cycle of ten drops with corner 1-4-5. Each loaded container must withstand 3 cycles without spilling or sifting of contents.

§ 178.218 Specification 23G; special cylindrical fiberboard box for high explosives.

§ 178.218-1 Compliance.

(a) Required in all details.

§ 178.218-2 Definition.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

§ 178.218-3 Side walls, ends, and interior.

(a) Side walls. To be not less than four-ply of continuous fiber sheets convolutely or spirally wound; combined strength to be not less than 300 pounds, dry; combined thickness to be not less than 0.050" for containers not exceeding 10 pounds gross weight and not less than 0.060" for containers over 10 pounds gross weight.

(b) *Ends.* To be of one or more plies of fiberboard sufficiently strong to withstand prescribed tests. Wax or plastic material with fiberboard inserts authorized provided the completed container will withstand the prescribed tests at temperatures from zero to one hundred thirty degrees F.

(c) *Interior.* Interior of the container must be lined or so treated as to prevent penetration by the commodity with which the container is filled for shipping.

§ 178.218-4 Stitching staples.

Stitching staples must be made in such a configuration that their holding capability as installed will not be less than that of flat steel staples 3/32 × 0.019 inch in cross section and not less than 7/16-inch wide. Material used must be at least equivalent to copper coated steel in nonsparking quality.

[Amdt. 178-12, 35 FR 11687, July 22, 1970]

§ 178.218-5 Tape.

(a) Coated with animal glue at least equal to No. 1¾ Peter Cooper standard or other adhesive equivalent in tensile properties and resistance to deterioration. Cloth tape of strength, across the woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 Kraft paper, total weight 80 pounds per ream (480 sheets, 24″ × 36″); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape.

§ 178.218-6 Test of board.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

§ 178.218-7 Type of container authorized.

(a) One cylindrical tube or;

(b) Two cylindrical tubes butted together and taped or glued completely around circumference at joints to make positive closure.

(c) Open ends to be closed in such a manner as to give complete closure which will withstand prescribed tests.

§ 178.218-8 [Reserved]

§ 178.218-9 Authorized size and weight limit.

(a) Maximum authorized outside diameter of container is 12″.

(b) Maximum authorized gross weight of container is 65 pounds.

§ 178.218-10 Marking.

(a) On each container by symbol as follows:

DOT-23G * * *

(1) Stars to be replaced by *authorized gross weight* (for example, DOT-23G40, DOT-23G65, etc.).

(2) Name or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) Size of markings: Specification markings prescribed in paragraph (a)(1) of this section must be at least ½ inch high; other markings must be legible.

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38180, Sept. 9, 1976]

§ 178.218-11 Special tests.

(a) *By whom and when.* By or for each plant making the boxes; at beginning of manufacture and at 6-month intervals thereafter; on largest size, by weight. Smaller sizes need not be tested if they have the same or equivalent construction. Report of results, with all pertinent data, to be maintained on file for one year; copy to be filed with the Associate Director for OE.

§ 178.218-12 Material.

(a) Box material must be not less than 300 pound test board when commercially dry.

(b) Box material must also have 200-pound test strength, moisture content not over 30 percent and puncture strength not less than 200 units, as determined by General Electric Puncture Tester using an average obtained from a series of five tests, as follows:

(c) Immediately after exposure for 3 days under either of the following conditions.

(1) 70 percent humidity at 100° F.

(2) 90 percent humidity at 75° F.

§ 178.218-13 Completed containers.

(a) Samples must pass the following tests immediately after exposure for 2 weeks to 90 percent humidity at 75° F. or 70 percent humidity at 100° F.; loaded containers shall contain dummy contents of shape and weight same as expected contents.

(1) Three loaded samples to be tested. Each must withstand end to end pressure of at least 500 pounds with deflection of over 1½"; speed of compression tested to be ½" per minute plus ¼" minus ¼" per minute.

(2) Three loaded samples to be tested. Each must withstand side to side pressure of at least 500 pounds without deflection of over ½"; except that for boxes with fluted crimped ends the deflection shall not exceed ¾"; speed of compression tested to be ½" per minute plus ¼" minus ¼" per minute.

(3) Three loaded samples to be tested. Each must withstand, without rupture, four 4-foot drops diagonally on the end more likely to cause rupture on impact.

(4) Three loaded samples to be tested. Each must be dropped once, flat on its side, across another similar package lying flat upon the ground with its longitudinal axis at right angles to container dropped. Drops must be made from a height four feet above the topmost point of the container on the ground.

(b) As an alternate to compression test requirements of paragraphs (a)(1) and (2) of this section, samples must pass the following tests immediately after exposure for 2 weeks to 90 percent humidity at 75° F. or 70 percent humidity at 100° F.; loaded containers shall contain dummy contents of shape and weight same as expected contents. Static loading tests as specified herein must be conducted with the prescribed weight in place for at least 60 minutes, with deflection of container not in excess of the following:

(1) Three loaded samples to be tested. Each container must be capable of withstanding end-to-end pressure of at least 375 pounds without deflection over 1½ inches.

(2) Three loaded samples to be tested. Each container must be capable of withstanding side-to-side pressure of at least 350 pounds without deflection over ½ inch.

§ 178.219 Specification 23H; fiberboard boxes.

§ 178.219-1 Compliance.

(a) Required in all details.

§ 178.219-2 Definitions.

(a) Terms such as "200-pound test" mean minimum strength, Mullen or Cady test.

(b) "Joints" are where edges of parts of box are connected together in setting up box.

(c) "Seams" are where edges of parts of box are visible, except joints, when box is closed.

§ 178.219-3 Solid fiberboard.

(a) To be 3-ply or more; both outer plies waterproofed.

§ 178.219-4 Stitching staples.

Stitching staples must be made in such a configuration that their holding capability as installed will not be less than that of flat steel staples ³⁄₃₂ × 0.019 inch in cross section and not less than ⁷⁄₁₆-inch wide. Material used must be at least equivalent to copper coated steel in nonsparking quality.

[Amdt. 178-12, 35 FR 11687, July 22, 1970; Amdt. 178-25, 36 FR 18469, Sept. 15, 1971]

§ 178.219-5 Tape.

(a) Coated with glue at least equal to No. 1¾ Peter Cooper standard. Cloth tape of strength, across the woof, at least 70 units, Elmendorf test. Sisal tape of 2 sheets of No. 1 kraft paper, total weight 80 pounds per ream (500 sheets, 24″×36″); sheets to be combined with asphalt and reinforced by unspun sisal fibers completely embedded in the asphalt and extending across the tape.

§ 178.219-6 Test.

(a) Acceptable board must have prescribed strength, Mullen or Cady test, under test as follows:

(1) Clamp board firmly in machine and turn wheel thereof at constant speed of approximately 2 revolutions per second.

(2) Six punctures required, 3 from each side; all results but one must show prescribed strength.

(3) Board failing may be retested by making 24 punctures, 12 from each side; when all results but 4 show prescribed strength the board is acceptable.

§ 178.219-7 Type authorized.

(a) Of solid fiberboard, telescoping type construction without recessed heads. Box to consist of top and bottom sections, divided equally or unequally, and inner lining tube or full depth cover 2-piece telescope type in which case the lining tube may be omitted. The lining tube, when required, must be staple stitched to the lower section of the box to give in effect a 2-piece box.

(b) Hand-holes oval in shape, not more than 1 inch in width by 3 inches in length and horizontal with top score line, are authorized in ends of top section of full depth cover telescope type boxes.

§ 178.219-8 Inside packing and size limits.

(a) As prescribed in § 178.219-11.

§ 178.219-9 Forming.

(a) Parts must be cut true to size and so creased and slotted as to fit closely into position without cracking, surface breaks, separation of parts outside of crease, or undue binding.

§ 178.219-10 Joints.

(a) Lapped at least 1½ inches from center of scoreline; staple stitched at 2½-inch intervals and within 1 inch of each end of joint; 2 banks of staple stitches in each joint.

§ 178.219-11 Authorized gross weight (when packed) and parts required.

(a) Box to be of solid fiberboard special waterproofed at least 300-pound test, and weighing at least 250 pounds per thousand square feet. Tubes to be of solid fiberboard at least 200-pound test and of 1 piece with adjoining edges staple stitched or taped.

(b) Authorized gross weight: 65 pounds when 2 or more lining tubes are used to divide the box into 2 or more compartments; 65 pounds when 1 or more lining tubes are used and contents will consist of 1 cartridge only or of black powder in bags; 35 pounds in all other cases except that boxes having a single solid fiberboard lining tube, the fiberboard weighing at least 283 pounds per 1,000 square feet, are authorized for 65 pounds gross weight. Boxes of 2-piece telescope type having full depth cover are authorized for 65 pounds gross weight.

§ 178.219-12 Closing for shipment.

(a) By any method capable of withstanding tests prescribed by § 178.219-16 without failure.

§ 178.219-13 Marking.

(a) On each container. Symbol in rectangle as follows:

DOT-23H * * *

(1) Stars to be replaced by authorized gross weight (for example DOT-23H35 or DOT-23H65).

(2) Name and address or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

(3) Size of markings: Specification markings prescribed in paragraph (a)(1) of this section must be at least ½ inch high; other markings must be legible.

[29 FR 18951, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976; 41 FR 56807, Dec. 30, 1976]

§ 178.219-14 Special tests.

(a) *By whom and when.* By or for each plant making the boxes; at beginning of manufacture and at six-month intervals thereafter; on largest size, by weight. Smaller sizes need not be tested if they have the same or equivalent construction. Report of results, with all pertinent data, to be maintained on file for one year; copy to be filed with the Associate Director for OE.

§ 178.219-15 Material.

(a) Box material (special waterproofed board) must be 300-pound test board and weigh at least 250 pounds per thousand square feet when commercially dry.

(b) Box material must also have 200-pound test strength and moisture content not over 30 percent as follows:

(1) Immediately after exposure for 3 days to 90 percent humidity at 75° F.

(2) Immediately after it has been in contact with water for 3 hours under 3″ head at 75° F.

NOTE: The test shall be conducted on a sample no greater than 6 inches in diameter when exposed to water. The sample shall be rigidly fastened to a water column device so constructed as to provide at least a 3-inch head of water on the outer surface of the fiberboard sample. The water column device must be suspended in such manner that free circulation of air on the inner surface of fiberboard sample which is not exposed to water is permitted. After contact with water for 3 hours under conditions specified, the water column device shall be emptied, the sample blotted, and immediately subjected to Mullen or Cady test. (A 6-inch diameter pipe having a welded flange to which the sample is secured by a bolted ring flange is acceptable.)

§ 178.219-16 Controlled containers.

(a) Samples must pass the following immediately after exposure for 2 weeks to 90 percent humidity at 75° F.; loaded containers shall contain dummy contents of shape and weight of the expected contents, and shall be closed in same manner as for shipment:

(1) *Three loaded samples to be tested.* Each must withstand 200 drops in standard 7-foot revolving test drum with pointed hazard in place, without spilling any contents.

(2) *Three loaded samples to be tested.* Each must withstand end to end pressure of at least 500 pounds without deflection of over 1½″.

(3) Three empty samples to be tested. Each must withstand top to bottom pressure of at least 500 pounds without deflection of over ½ inch.

(b) As an alternate to the drum test specified in paragraph (a) of this section, 3 loaded samples must pass the drop test specified below:

(1) Box shall be dropped from height of 2 feet.

(2) Identification of face, edge, and corners. Facing one end (with the manufacturer's joint on the observer's right), the top of the box is designated as 1, the right side as 2, the bottom as 3, and the left side as 4. The near end is designated as 5 and the far end as 6. The edges are identified by the number of the two faces which make that edge, as for example, 1-2 identifies the edge where the top and right side meet and 2-5 the edge having the manufacturer's joint. The corners are identified by the number of the three faces which meet to form that corner, as for example, 1-2-5 identifies the corner where the top, the right side, and the near end meet.

(c) Drop sequence as follows:

(1) A corner drop on 1-2-5.

(2) An edge drop on the shortest edge radiating from that corner (usually 2-5).

(3) An edge drop on the next shortest edge radiating from that corner (usually 1-5).

(4) An edge drop on the longest edge radiating from that corner (usually 1-2).

(5) A flatwise drop on one of the smallest faces (usually end 5 or 6).

(6) A flatwise drop on the opposite smallest face.

(7) A flatwise drop on one of the medium faces (usually side 2 or 4).

(8) A flatwise drop on the opposite medium face.

(9) A flatwise drop on one of the largest faces (usually top 1 or bottom 3).

(10) A flatwise drop on the opposite large face.

(d) This completes one cycle of ten drops. Commence the next cycle with a drop on the corner diagonally opposite through the box to the corner on which the first drop was made, on corner 3-4-6. Commence the third cycle of ten drops with corner 1-4-5. Each loaded container must withstand 3 cycles without spilling or sifting of contents.

§ 178.224 Specification 21C; fiber drum.

§ 178.224-1 Construction requirements.

(a) Parts and dimensions as follows:

(1) Drums for dry products; minimum requirements unless otherwise stated:

Net weight of contents (pounds) not over	Capacity, maximum (gals.) (not over)	Diameter inside maximum (inches)	Sidewall strength (lbs.)[1] [2]	Tops and bottoms				
				Fiber[3]		Steel, (U.S. gauge)	Wood Thickness (inches)	
				Thickness (inches)	Strength		Solid[4] [5] [6]	Plywood at least 3-ply construction
60	5	11¼	500	0.090	600	28	13/16	3/16
60	20	18⅛	600	.120	800	28	13/16	3/16
115	20	18⅛	700	.120	800	26	13/16	⅜
115	55	23	800	.160	1100	26	13/16	7/16
250	55	23	900	.200	1200	24	13/16	7/16
400	75	23	1000	.220	1300	24	13/16	7/16

[1] Mullen or Cady Test. Either of the following test methods may be used. When more than single ply, test shall be determined from the summation of the tests of individual plies; or, when test is made on a complete drum, the punctures shall be made from the exterior to the interior surface in which case the values for sidewall shall be not less than 80 percent of the value in the above table and the values for fiber tops and bottoms shall be not less than the value in the above table. There shall be a minimum of six tests and the average shall be not less than the prescribed minimum requirements.

[2] Sidewalls. Sidewalls to be convolutely wound of fiberboard at least 0.012 inch thick the plies being secured together with adhesives; or may consist of an outer shell and an inner tube each convolutely wound with each fiberboard ply not less than 0.012 inch thick and secured together with adhesive. Drums may contain barrier or lining materials.

[3] When made of 2 or more discs, the discs must be fastened together with adhesive.

[4] Joints in head must be Linderman joints, glued, except as specified in footnote 5.

[5] Wooden heads at least one-half inch thick having kraft paper glued on both sides at all contact areas with water-resistant adhesive are authorized provided tests prescribed in § 178.224-2 are successful. Joints of any type are authorized.

[6] Minimum thickness may be reduced to 25/32 inch for lumber dressed two sides.

[29 FR 18951, Dec. 29, 1964, as amended by Order 67, 30 FR 7425, June 5, 1965; Order 71, 31 FR 9081, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.224-2 Type tests.

(a) Conditioning: Prior to testing, drums shall be conditioned at 50 percent relative humidity plus or minus 2 percent and 75° F. plus or minus 3° F. for at least 48 hours.

(b) Drop tests: Samples taken at random filled with dry finely powdered material to authorized net weight and closed as for use must withstand the following four foot drop tests on the part specified without leakage or serious rupture. No single drum shall be subjected to more than one of the following tests. Drums with wood heads shall be dropped with grain of wood in cover parallel to concrete surface.

(1) Top chime, diagonally onto solid concrete.

(2) Bottom chime, diagonally onto solid concrete.

(3) Sidewall, over a 2-inch x 6-inch timber resting on solid concrete with 6-inch leg vertical; drop to be made with drum in the horizontal position at right angles to the timber.

(4) The closure or on any other part which may be considered weaker onto solid concrete.

(c) Compression test: An empty drum shall withstand either of the following compression tests, in accordance with the following table, without buckling of the sidewalls sufficient to cause damage to its expected contents; but in no case shall the maximum deflection be more than one inch.

Maximum net weight	Maximum capacity (gallons)	Maximum inside diameter (inches)	Compression (pounds)	
			Static[1]	Dynamic[2]
60	5	11¼	1200	1600
60	20	18½	1200	1600
115	20	18½	1200	1600
115	55	23	1500	2000
250	55	23	1800	2400
400	75	23	2100	2800

[1] Static Test. Compression as specified must be applied to full area of top cover of drum for period of 48 hours.

[2] Dynamic Test. Compression as specified must be applied end to end. Speed of compression tester to be one-half inch plus or minus one-fourth inch per minute.

(d) The tests described above must be made by any company starting production, for each plant location of manufacture, on samples taken as random of each type and diameter of container and must be repeated every 4 months or less during production. Samples last tested must be retained until further tests are made. The tests and procedure described may be conducted at one central laboratory when testing facilities are not available at all plants.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18951, Dec. 29, 1964, as amended by Order 67, 30 FR 7425, June 5, 1965; Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.224-3 [Reserved]

§ 178.224-4 Marking.

(a) On each container as follows:

(1) Drums for dry products must be marked DOT-21C followed by the authorized net weight to which drum was constructed, for example, DOT-21C115.

(2) Name or symbol of person making the marks specified in paragraph (a) (1) of this section and located just above, below, or following those marks. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18951, Dec. 29, 1964, as amended by Order 71, 31 FR 9081, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.224-4 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.225 Specification 21P; fiber drum overpack for inside plastic container.

[Order 71, 31 FR 9081, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.225-1 Compliance.

(a) Required in all details.

[Order 71, 31 FR 9081, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.225-2 Construction requirements.

(a) Fiber drum overpack for inside plastic containers as prescribed in Part 173 of this chapter. Fit of fiber drum overpack shall provide support for inside plastic container in such manner as to avoid wrinkling, buckling, or suspension of inside plastic container by any closure protruding through top head.

(b) Fiber sidewalls shall consist of one or more multiple-ply shells or tubes, convolutely wound of fiberboard at least 0.012 inch thickness with plies of each component secured together with adhesive: Steel parts used shall be of low carbon, open hearth, or electric steels; drum overpack shall be of tight-head or full removable cover type, straight sided, with top and bottom heading secured to sidewall by an efficient means in accordance with the following detailed, minimum requirements:

Marked[1] (rated) capacity of inside plastic container not over (gallons)	Authorized maximum net weight of liquid contents not over (lbs.)	Sidewall strength[2] (lbs.)	Fiber drum overpack parts[5] [6]							
			Top heads and bottom heads				Combination fiber-steel bottoms			
			All fiber[3]		All steel		Fiber component		Steel component	
			Thickness (inch)	Strength[2] (pounds)	Gauge	Thickness[4] (inch)	Thickness (inch)	Strength[2] (pounds)	Gauge	Thickness[4] (inch)
6½	105	600	0.120	800	28	0.0129				
15	245	700	.160	1,100	26	.0159	0.090	600	28	0.0129
30	350	900	.200	1,200	24	.0209	.120	800	26	.0159

Marked[1] (rated) capacity of inside plastic container not over (gallons)	Authorized maximum net weight of liquid contents not over (lbs.)	Sidewall strength[2] (lbs.)	Fiber drum overpack parts[5] [6]							
			Top heads and bottom heads				Combination fiber-steel bottoms			
			All fiber[3]		All steel		Fiber component		Steel component	
			Thickness (inch)	Strength[2] (pounds)	Gauge	Thickness[4] (inch)	Thickness (inch)	Strength[2] (pounds)	Gauge	Thickness[4] (inch)
30	450	1,000	.220	1.300	24	.0209	.160	1,100	26	.0159
55	600	1,200	.240	1,500	24	.0209	.160	1,100	26	.0159

[1] For capacity tolerances refer to applicable specifications of inside plastic containers.

[2] Mullen or Cady test. Either of the following test methods may be used. When more than single ply, test shall be determined from the summation of the tests of individual plies; or when test is made on a complete drum, the punctures shall be made from the exterior to the interior surface, in which case the values for sidewall shall be not less than 80 percent of the value in the above table and the values for fiber tops and bottoms shall be not less than the value in the above table. There shall be a minimum of 6 tests and the average shall be not less than the prescribed minimum requirements.

[3] When made of 2 or more discs, the discs must be bonded together with adhesive.

[4] Thickness shall be measured at any point on the steel part not less than ⅜ inch from an edge.

[5] Two holes not exceeding ¼ inch each are permitted diametrically opposite each other in the overpack body and three holes not exceeding 3/16 inch in diameter on centers 120 degrees apart in the bottom head. Top head may have not more than 2 holes or suitable size to provide for protruding closures. Closures shall not protrude above plane of top chime.

[6] Overpack interior shall be free of projections, burrs, or any edges that might cause damage to inside plastic container.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Order 71, 31 FR 9081, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.225-3 Marking.

(a) Maker of overpack and assembler of the composite container shall place a marking on side of container by printing, lithography or stamping with weather resistant ink in letters not less than ½ inch high as follows:

(1) Marking by maker of overpack.

(i) DOT-21P * * *; stars to be replaced by the authorized net weight for liquid products for which drum was constructed, for example, DOT-21P/450.

(ii) Name or symbol of maker must be registered with the Associate Director for OE and be located just above, below, or following the mark specified in paragraph (a)(1)(i) of this section.

(2) Marking by assembler of composite container.

(i) Maker or other party assuming responsibility for compliance with specification requirements shall add a marking to the overpack marker's marking as specified by paragraph (a)(1)(i) of this section identifying the inside plastic container specification number. For example, DOT-21P/450/2SL. "STC" shall be added to the marking when inside container is authorized only for single trip service. For example, DOT-21P/450/2U STC.

(ii) The name or symbol of the assembler to be located near the marking specified in paragraph (a)(2)(i) of this section; symbol must be registered with the Associate Director for OE.

[Order 71, 31 FR 9081, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.225-4 Compression test.

(a) Prior to testing, drums shall be conditioned at 50 percent plus or minus 2 percent relative humidity and 75° F. plus or minus 3° F. for at least 48 hours.

(b) An empty fiber drum overpack shall withstand either of the following compression tests without buckling of the sidewall sufficient to cause damage, but in no case shall the maximum top to bottom deflection be more than ½ inch:

Fiber drum overpack for plastic inside container of marked (rated) capacity not over (gallons)	Compression	
	Static[1] (pounds)	Dynamic[2] (pounds)
15	1,125	1,500
30	1,800	2,400
55	2,400	3,200

[1] Static test. Compression as specified must be applied to entire bearing surface of top of drum for a period of 48 hours.

[2] Dynamic test. Compression as specified must be applied end to end. Speed of compression tester to be ½ inch plus or minus ¼ inch per minute.

(c) Test to be made at start of production and repeated at 4-month intervals for each size of each type drum overpack manufactured. Record of test results shall be maintained in current status by each manufacturer at each producing plant.

[Order 71, 31 FR 9081, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.225-5 Assembly and testing of composite container.

(a) The method employed for assembly shall be such as not to cause damage to either component.

(b) The party doing assembly shall be responsible for compliance with § 178.225-2(a) and for compliance with test requirements specified by applicable inside plastic container specifications in Part 178.

[Order 71, 31 FR 9081, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.226 Specification 29; mailing tubes.

§ 178.226-1 Compliance.

(a) Required in all details.

§ 178.226-2 Cushioning.

(a) Inside containers, if any, must fit closely in tube or be properly cushioned.

§ 178.226-3 Construction.

(a) Of fiber at least ⅛" thick; metal bottom and metal screw-cap top, or telescope type with fixed metal ends.

§ 178.226-4 Marking.

(a) Each container must be marked to show:

(1) DOT-29.

(2) The name or symbol of person making the mark specified in paragraph (a)(1) of this section. Symbol, if used, must be registered with the Associate Director for OE.

[Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

Subpart G—Specifications for Bags, Cloth, Burlap, Paper or Plastic

SOURCE: 29 FR 18966, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§ 178.230 Specification 36A; lined cloth bags (triplex).

§ 178.230-1 Compliance.

(a) Required in all details.

§ 178.230-2 Capacity.

(a) Not over 100 pounds, net.

§ 178.230-3 Cloth.

(a) Osnaburg cotton cloth at least 8½ ounces per square yard.

NOTE 1: Because of the present emergency and until further order of the Department, cloth of 40-inch width, 2.11 yards per pound, may be used, provided creped paper is of two-way stretch construction.

§ 178.230-4 Paper.

(a) Shipping sack Kraft, creped. A "ream" as used herein means 500 sheets 24 inches by 36 inches before creping.

§ 178.230-5 Assembly.

(a) Either of the following:

(1) *Single bag.* Cloth-lined with 2 sheets of creped paper, each at least 35 pounds per ream, cemented together and to cloth. Combined tensile strength at least 100 pounds, warp and fill.

(2) *Triple bag.* Outer of cloth; intermediate of 2 thicknesses of creped paper, each at least 30 pounds per ream, cemented together with asphalt so as to weigh 90 pounds per ream; inner of creped paper at least 45 pounds per ream.

§ 178.230-6 Seams.

(a) To be dust-tight.

§ 178.230-7 Test.

(a) The finished container, filled and closed as for shipment, must be capable of withstanding drop test of 4 feet without sifting.

§ 178.230-8 Marking.

(a) Marking on each container by marks at least 1" high as follows:

(1) DOT-36A.

(2) Name and address or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18966, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.230-9 Closing for shipment.

(a) By double tying with steel wires at least No. 16 Birmingham wire gauge; inner bags, if any, to have edges rolled in before outer bag is tied.

§ 178.233 Specification 36B; burlap bags, lined.

§ 178.233-1 Compliance.

(a) Required in all details.

§ 178.233-2 Capacity.

(a) Not over 100 pounds, net.

§ 178.233-3 Burlap.

(a) At least equal in quality and strength to 10-oz., 40" (10/40), Calcutta A and/or B mill grade. Thread count at least 11 per 37/40", porter, and 12 per inch, shot; this to be an average of 6 counts.

§ 178.233-4 Paper.

(a) Shipping sack Kraft, creped; at least 25 pounds per ream (500 sheets 24" x 36") before creping.

§ 178.233-5 Assembly.

(a) Burlap to be lined with 2 sheets of creped paper cemented together and to burlap.

(b) Adhesive between paper sheets to be asphalt, melting point 150° F., at minimum rate of 110 pounds per ream.

(c) Adhesive between paper and burlap to be either:

(1) Curing rubber latex at minimum rate of 40 pounds, dry weight, per ream.

(2) Asphalt, any desirable type, at minimum rate of 110 pounds per ream.

§ 178.233-6 Stretch of paper lining.

(a) At least equal to that of burlap in direction of warp and fill and equal to 10 percent in diagonal direction.

§ 178.233-7 Seams.

(a) By cementing or taping to give seam strength at least equal to that of bag material and prevent sifting.

§ 178.233-8 Tests.

(a) The finished container, filled and closed as for shipment, must be capable of withstanding drop test of 4 feet on the butt without sifting or rupture of burlap or liners.

§ 178.233-9 Marking.

(a) Marking on each container by marks at least 1" high as follows:

(1) DOT-36B.

(2) Name and address or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18966, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.233-10 Closing for shipment.

(a) As specified for seams, § 178.233-7; or, by tying with 2 steel wires of at least No. 16 Birmingham wire gauge.

§ 178.234 Specification 36C; burlap bags, paper lined.

§ 178.234-1 Compliance.

(a) Required in all details.

§ 178.234-2 Capacity.

(a) Not over 100 pounds, net.

§ 178.234-3 Burlap.

(a) At least equal in quality and strength to 7½ ounce, 40 inch (7½/40) Calcutta A and/or B mill grade. Thread count at least 9 per $^{37}/_{40}$ inch, porter, and 9 per inch, shot; this to be an average of 6 counts.

§ 178.234-4 Paper.

(a) Shipping sack Kraft, creped; at least 30 pounds per ream (500 sheets 24" × 36") before creping.

§ 178.234-5 Assembly.

(a) Burlap to be lined with 1 sheet of creped paper cemented to the burlap.

(b) Adhesive between paper and burlap to be asphalt, any desirable type, at a minimum rate of 110 pounds per ream.

§ 178.234-6 Stretch of paper lining.

(a) At least equal to that of burlap in direction of warp and fill and equal to 10 percent in diagonal direction.

§ 178.234-7 Seams.

(a) By cementing or taping to give seam strength at least equal to that of bag material and prevent sifting.

§ 178.234-8 Test.

(a) The finished container, filled and closed as for shipment, must be capable of withstanding drop test of 4 feet on the butt without sifting or rupture of burlap liners.

§ 178.234-9 Marking.

(a) Marking on each container by marks at least 1" high as follows:

(1) DOT-36C.

(2) Name and address or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18966, Dec. 29, 1964. Redesignated at 36 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.234-10 Closing for shipment.

(a) As specified for seams, § 178.234-7; or by tying with 2 steel wires of at least No. 16 Birmingham wire gauge, or any other type of equal efficiency that will be sift-proof and insure equal strength to body of bag.

§ 178.236 Specification 44B; multiwall paper bags.

§ 178.236-1 Compliance.

(a) Required in all details.

§ 178.236-2 Paper.

(a) Shipping sack kraft paper, plain, or extensible plain, shall conform to the average requirements specified in paragraph (a)(1) or (a)(2) of this section.

(1) Shipping sack, kraft paper, plain:[1]

Nominal basis weight (500 sheets, 24" × 36")[2] (pounds)	Minimum average dry tearing strength (grams)		Minimum average dry tensile strength per inch width (pounds)	
	M.D.[3]	Total M.D. plus C.D.[3]	C.D.[3]	Total C.D. plus M.D.[3]
40	88	188	14	41
50	110	235	19	53
60	132	282	23	64
70	154	329	27	74

[1] Shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating, or impregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing and shall comply with the requirements in paragraph (a)(1) of this section.

[2] A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

[3] M.D. means machine direction. C.D. means cross direction.

(2) Shipping sack, extensible kraft paper, plain:[1]

Nominal basis weight (500 sheets, 24" × 36")[2] (pounds)	Minimum dry tearing strength (grams)		Minimum tensile energy absorption ft./lbs. per square foot of paper	
	M.D.[3]	Total M.D. plus C.D.[3]	C.D.[3 4]	Total C.D. plus M.D.[3 4]
40	88	188	4.5	14.0
50	110	235	5.6	17.0
60	132	282	7.0	20.0
70	154	329	8.0	23.0
80	176	376	9.0	26.0

[1] Extensible shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating or inpregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing, and shall comply with the requirements in paragraph (a)(2) of this section.

[2] A tolerance of minus 10 percent of the basis weight of individual plies of extensible shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all; plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine not including finish subsequently applied, such as coating or printing.

[3] M.D. means machine direction. C.D. means cross direction.

[4] Variations in cross-direction tensile energy absorption of not more than 0.5 units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the machine-direction tearing strength in the ratio of twenty units of tearing strength to one unit of tensile energy absorption, and variations in total tensile energy absorption of not more than one unit below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tearing strength in the same ratio. Similarly, variations in machine-direction tearing strength of not more than ten units below minimum requirements will be permitted, provided variations are compensated by an increase in cross-direction tensile energy absorption in the ratio of one unit of tensile energy absorption to twenty units of tearing strength; and variations in total tearing strength of not more than twenty units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tensile energy absorption in the same ratio. Conformance with the requirements of Table shall be established by comparing the sum of the basis weighs and tests for all of the plies specified in the construction of the bag, with the sum of the specified basis weights and tests for the respective papers comprising the different plies. All requirements in this table are for a paper conditioned to a relative humidity of 50 percent at a temperature of 23° C (73° F).

(b) Asphalt laminated or polyethylene coated shipping sack kraft paper when used shall comply with the following requirements:

Type paper	Minimum average dry tearing strength (grams)		Minimum average dry tensile strength per inch width (pounds)		Heat resistance hours at 150° F. without impairing function of sack	Maximum average water-vapor permeability from both sides at 50 percent R.H. and 73° F. g/m, 2/24 hours	
	M.D.	Total M.D. plus C.D.	C.D.	Total C.D. plus M.D.		Uncreased	Creased [1]
Asphalt laminated [2] [4]	110	235	19	53	5	9.0	15.0
10PE-50 1/50-10PE [3]	110	235	19	53	5	7.0	12.0
15PE-50 1/50-15PE [3]	110	235	19	53	5	4.5	7.5

[1] Creasing at 40° F.

[2] Asphalt laminated kraft paper when used as a wall in fabricated sacks, shall conform to the requirements of paragraph (b) of this section and shall consist of two sheets of kraft paper, the total basis weight of the two paper plies not less than 50 pounds per ream (500 sheets, 24″ × 36″), continuously and uniformly laminated together with an average of no less than 25 pounds of asphalt per ream (500 sheets, 24″ × 36″). Tolerance of minus 5 percent will be allowed on individual components. The total basis weight of the finished combination shall not exceed 100 pounds per ream (500 sheets, 24″ × 36″). An asphalt laminated kraft wall meeting these requirements may be substituted for a plain kraft wall of 50 pounds basis or less, provided it meets the specification.

[3] Polyethylene-coated shipping sack kraft paper. The polyethylene-coated kraft paper when used as walls in fabricated sacks shall meet the heat resistance and water-vapor permeability requirements as specified in the table. A tolerance of minus 10 percent will be allowed for the lot sample average coating weight of polyethylene on shipping sack kraft paper. Minimum samples for testing shall comprise not less than 3 specimens 16 square inches each selected representatively from each polethylene-coated wall of each sack in the lot sample. When barrier sheets are based on extensible kraft the weight of the barrier material shall be in addition to the basis weight of the paper.

[4] Asphalt laminated extensible kraft paper must consist of two sheets of extensible kraft paper, the total basis weight of the paper in the finished combination being not less than 50 pounds per ream (24 × 36—500) with neither sheet weighing less than 23 pounds continuously and uniformly laminated together, with an average of not less than 25 pounds of asphalt per ream (24 × 36—500). In determining the basis weight and test conformance of bags containing an asphalt laminated extensible kraft wall, the asphalt laminated extensible kraft wall shall be treated as if it were a single extensible kraft wall or combination of walls of 10 pounds lower total paper basis weight than the sum of the nominal basis weight in the asphalt laminated wall, but in no case shall be treated as less than the equivalent of a 50 pounds basis weight wall.

(c) Laminating materials: Any laminant other than asphalt or other water-vapor barrier walls may be used provided they meet the requirements in paragraph (b) of this section.

(d) All values in paragraphs (a) and (b) of this section are for paper having a moisture content in equilibrium with an atmosphere having a relative humidity of 50 percent plus or minus 2 percent at a temperature of 73° F. plus or minus 3.5° F. following preconditioning of the test specimens to a moisture content between 3 and 5.5 percent by exposure to relatively dry air having a temperature no greater than 140° F.

(e) Conformance of sacks with paper strength requirements shall be established by comparing the sums of the test values for all the walls of the new and unused sack with the sums of the respective strength values specified in paragraphs (a) and (b) of this section for the different walls of the sack.

(1) Variation in cross direction dry tensile strength of not more than 2 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall of the sack, provided the variation is compensated for by a machine direction tearing strength test value in excess of the minimum requirement obtained from the tables, in the ratio of 5 units of tearing strength for each unit of dry tensile strength test below the minimum requirement; and vari-

ation in combined dry tensile strength of not more than 4 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall used provided the variation is compensated for by a combined tearing strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of combined tearing strength for each unit of dry tensile strength test below the minimum requirement. Similarly, variation in machine direction tearing strength of not more than 10 units below the minimum requirement will be permitted for each wall, provided the variation is compensated for by a cross direction dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 1 unit of dry tensile strength for each 5 units of tearing strength test below the minimum requirement; and variation in combined tearing strength of not more than 20 units below the minimum requirement obtained from the tables will be permitted for each wall provided the variation is compensated for by a combined dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of tearing strength for each unit of dry tensile strength below the minimum requirement.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18966, Dec. 29, 1964, as amended by Order 66, 30 FR 5758, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-59, 44 FR 66203, Nov. 19, 1979]

§ 178.236–3 Construction.

(a) Bags must be at least 4 thicknesses of paper; this must be heavy duty shipping sack kraft paper, conforming to the requirements of § 178.236-2(a) and (b) or equivalent, with a minimum total basis weight of 200 pounds of paper (500 sheets, 24″ × 36″). Outer sheet must be of water-resistant stock and at least 60 pounds basis weight, inner sheets not less than 40 pounds basis weight. Bags to be of "satchel bottom" construction; bottoms to be reinforced with a kraft paper patch at least 30 pounds basis weight. Other bottoms of equal efficiency are authorized.

(b) Or, bags must be at least 2 thicknesses of paper; this must be heavy duty shipping sack kraft paper, or equivalent with a minimum total basis weight of 110 pounds (500 sheets, 24″ × 36″), fastened together with waterproof composition reinforced with jute, sisal, cotton, or other yarn or cord imbedded in the composition and criss-crossed at intervals of not over ½″, approximately so as to give approximately the same tensile strength for both width and length. Bags to be of "satchel bottom" construction. Other bottoms of equal efficiency are authorized.

(c) Moistureproof barrier sheets of paper, if used, must meet the requirements of § 178.336-2(b) and shall be considered as one thickness of paper and shall be counted as 50 pounds basis weight (500 sheets, 24″ × 36″).

§ 178.236–4 Adhesive.

(a) Moisture resistant adhesive must be used on all seams, joints, and bottom patch, if any.

§ 178.236–5 Closure.

(a) For 4-ply bags: Inner (fourth) ply to be diamond folded loose; the third ply to be diamond folded and silicated across all its overlapping folds; the two outer plies to be diamond folded, and cross sealed, front to back and side to side, with gummed tape extending at least 2 inches down sides of bag; sealing tape must be 4″ wide, of No. 1 Kraft paper, 90 pounds basis weight (500 sheets, 24″ × 36″), or equivalent, and having a Mullen or Cady test, of not less than 90 percent of basis weight. Other closures of equal efficiency are authorized.

(b) For all bags: Any closure for the top which is equal in efficiency to that of the bottom, is authorized.

§ 178.236–6 Tests for shipment.

(a) Bags as prepared for shipment must be able to withstand four 4-foot drops, one on each end and one each on opposite sides, without sifting or rupture.

§ 178.236-7 Marking.

(a) Marking on each bag with letters and figures at least ½ inch high in rectangle as follows:

DOT-44B

(b) Each bag must also be marked with the name and address or symbol of the person making the mark specified in paragraph (a) of this section and be located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18966, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38183, Sept. 9, 1976]

§ 178.237 Specification 44C; multiwall paper bags.

§ 178.237-1 Compliance.

(a) Required in all details.

§ 178.237-2 Paper.

(a) Shipping sack kraft paper, plain, or extensible plain, shall conform to the average requirements specified in paragraphs (a)(1) or (a)(2) of this section.

(1) Shipping sack, kraft paper, plain: [1]

Nominal basis weight (500 sheets, 24" × 36") [2] (pounds)	Minimum average dry tearing strength (grams)		Minimum average dry tensile strength per inch width (pounds)	
	M.D. [3]	Total M.D. plus C.D. [3]	C.D. [3]	Total C.D. plus M.D. [3]
40	88	188	14	41
50	110	235	19	53
60	132	282	23	64
70	154	329	27	74

[1] Shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating, or impregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing and shall comply with the requirements in paragraph (a)(1) of this section.

[2] A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

[3] M.D. means machine direction. C.D. means cross direction.

(2) Shipping sack, extensible kraft paper, plain: [1]

Nominal basis weight (500 sheets, 24" × 36") [2] (pounds)	Minimum dry tearing strength (grams)		Minimum tensile energy absorption ft./lbs. per square foot of paper	
	M.D. [3]	Total M.D. plus C.D. [3]	C.D. [3] [4]	Total C.D. plus M.D. [3] [4]
40	88	188	4.5	14.0
50	110	235	5.6	17.0
60	132	282	7.0	20.0
70	153	329	7.0	23.0
80	176	376	9.0	26.0

[1] Extensible shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating or impregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing, and shall comply with the requirements in paragraph (a)(2) of this section.

[2] A tolerance of minus 10 percent of the basis weight of individual plies of extensible shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect of deviation. The basis weight of paper means the basis weight as produced by the paper machine not including finish subsequently applied, such as coating or printing.

[3] M.D. means machine direction. C.D. means cross direction.

[4] Variations in cross-direction tensile energy absorption of not more than 0.5 units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the machine-direction tearing strength in the ratio of twenty units of tearing strength to one unit of tensile energy absorption, and variations in total tensile energy absorption of not more than one unit below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tearing strength in the same ratio. Similarly, variations in machine-direction tearing strength of not more than ten units below minimum requirements will be permitted, provided variations are compensated by an increase in cross-direction tensile energy absorption in the ratio of one unit of tensile energy absorption to twenty units of tearing strength; and variations in total tearing strength of not more than twenty units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tensile energy absorption in the same ratio. Conformance with the requirements of Table shall be established by comparing the sum of the basis weights and tests for all of the plies specified in the construction of the bag, with the sum of the specified basis weights and tests for the respective papers comprising the different plies. All requirements in this table are for a paper conditioned to a relative humidity of 50 percent at a temperature of 23° C (73° F).

(b) Asphalt laminated or polyethylene coated shipping sack kraft paper when used shall comply with the following requirements:

Type paper	Minimum average dry tearing strength (grams)		Minimum average dry tensile strength per inch width (pounds)		Heat resistance hours at 150° F. without impairing function of sack	Maximum average water-vapor permeability from both sides at 50 percent R.H. and 73° F. g/m, 2/24 hours	
	M.D.	Total M.D. plus C.D.	C.D.	Total C.D. plus M.D.		Uncreased	Creased [1]
Asphalt laminated [2] [4]	110	235	19	53	5	9.0	15.0
10PE-50 1/50-10PE [3]	110	235	19	53	5	7.0	12.0
15PE-50 1/50-15PE [3]	110	235	19	53	5	4.5	7.5

[1] Creasing at 40° F.

[2] Asphalt laminated kraft paper when used as a wall in fabricated sacks, shall conform to the requirements of paragraph (b) of this section and shall consist of two sheets of kraft paper, the total basis weight of the two paper plies not less than 50 pounds per ream (500 sheets, 24" x "), continuously and uniformly laminated together with an average of not less than 25 pounds of asphalt per ream (500 sheets, 24" x 36"). Tolerance of minus 5 percent will be allowed on individual components. The total basis weight of the finished combination shall not exceed 100 pounds per ream (500 sheets, 24" x 36"), An asphalt laminated kraft wall meeting these requirements may be substituted for a plain kraft wall of 50 pounds basis or less, provided it meets the specification.

[3] Polyethylene-coated shipping sack kraft paper. The polyethylene-coated kraft paper when used as walls in fabricated sacks shall meet the heat resistance and water-vapor permeability requirements as specified in the table. A tolerance of minus 10 percent will be allowed for the lot sample average coating weight of polyethylene on shipping sack kraft paper. Minimum samples for testing shall comprise not less than 3 specimens 16 square inches each selected representatively from each polyethylene-coated wall of each sack in the lot sample. When barrier sheets are based on extensible kraft, the weight of the barrier material shall be in addition to the basis weight of the paper.

[4] Asphalt laminated extensible kraft paper must consist of two sheets of extensible kraft paper, the total basis weight of the paper in the finished combination being not less than 50 pounds per ream (24 x 36—500) with neither sheet weighing less than 23 pounds continuously and uniformly laminated together, with an average of not less than 25 pounds of asphalt per ream (24 x 36—500). In determining the basis weight and test conformance of bags containing an asphalt laminated extensible kraft wall, the asphalt laminated extensible kraft wall shall be treated as if it were a single extensible kraft wall or combination of walls of 10 pounds lower total paper basis weight than the sum of the nominal basis weight in the asphalt laminated wall, but in no case shall be treated as less than the equivalent of a 50 pounds basis weight wall.

(c) Laminating materials: Any laminant other than asphalt or other water-vapor barrier walls may be used provided they meet the requirements in paragraph (b) of this section.

(d) All values in paragraphs (a) and (b) of this section are for paper having a moisture content in equilibrium with an atmosphere having a relative humidity of 50 percent plus or minus 2 percent at a temperature of 73° F. plus or minus 3.5° F. following preconditioning of the test specimens to a moisture content between 3 and 5.5 percent by exposure to relatively dry air having a temperature no greater than 140° F.

(e) Conformance of sacks with paper strength requirements shall be established by comparing the sums of the test values for all the walls of the new and unused sack with the sums of the respective strength values specified in paragraphs (a) and (b) of this section for the respective papers specified for the different walls of the sack.

(1) Variation in cross direction dry tensile strength of not more than 2 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall of the sack, provided the variation is compensated for by a machine direction tearing strength test value in excess of the minimum requirement obtained from the tables, in the ratio of 5 units of tearing strength for each unit of dry tensile strength test below the minimum requirement; and variation in combined dry tensile strength of not more than 4 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall used provided the variation is compensated for by a combined tearing strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of combined tearing strength for each unit of dry tensile strength test below the minimum requirement. Similarly, variation in machine direction tearing strength of not more than 10 units below the minimum requirement will be permitted for each wall, provided the variation is compensated for by a cross direction dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 1 unit of dry tensile strength for each 5 units of tearing strength test below the minimum requirement; and variation in combined tearing strength

of not more than 20 units below the minimum requirement obtained from the tables will be permitted for each wall provided the variation is compensated for by a combined dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of tearing strength for each unit of dry tensile strength below the minimum requirement.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18966, Dec. 29, 1964, as amended by Order 66, 30 FR 5758, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and further amended by Amdt. 178-59, 44 FR 66203, Nov. 19, 1979]

§ 178.237-3 Construction.

(a) Bags must be at least 4 thicknesses of paper unless otherwise specified in Part 173 of this subchapter; this must be heavy duty shipping sack Kraft paper conforming to the requirements of § 178.237-2 paragraphs (a) and (b), or equivalent, with a minimum total basis weight of 250 pounds of paper (500 sheets, 24 inches x 36 inches). Outer sheet must be of water resistant stock at least 60 pounds basis weight, inner sheets not less than 40 pounds basis weight. Bags to be of sewn, siftproof bottom construction. Other bottoms of equal efficiency authorized.

(b) Moisture proof barrier sheets of paper, if used, must meet the requirements of § 178.237-2(b) and shall be considered as one thickness of paper and shall be counted as 50 pounds basis weight (500 sheets, 24" × 36").

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18966, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, as amended by Amdt. 178-48, 43 FR 31143, July 20, 1978]

§ 178.237-4 Adhesive.

(a) Moisture resistant adhesive must be used on all seams, joints, and bottom patch, if any.

§ 178.237-5 Closure.

(a) For all bags: Any closure for the top which is equal in efficiency to that of the bottom, is authorized.

§ 178.237-6 Tests for shipment.

(a) Bags as prepared for shipment must be able to withstand four 4-foot drops, one on each end and one each on opposite sides, without sifting or rupture.

§ 178.237-7 Marking.

(a) On each bag with letters and figures at least ½ inch high in rectangle as follows:

DOT-44C

(b) Each bag must also be marked with the name and address or symbol of the person making the mark specified in paragraph (a) of this section and be located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18966, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38183, Sept. 9, 1976]

§ 178.238 Specification 44D; multiwall paper bags.

§ 178.238-1 Compliance.

(a) Required in all details.

§ 178.238-2 Paper.

(a) Shipping sack kraft paper, plain, or extensible plain, shall conform to the average requirements specified in paragraphs (a) (1) and (2) of this section.

(1) Shipping sack, kraft paper, plain:[1]

Nominal basis weight (500 sheets, 24" × 36")[2] [4] (pounds)	Minimum average dry tearing strength (grams)		Minimum average dry tensile strength per inch width (pounds)	
	M.D.[3]	Total M.D. plus C.D.[3]	C.D.[3]	Total C.D. plus M.D.[3]
40	88	188	14	41
50	110	235	19	53
60	132	282	23	64
70	154	329	27	74

[1] Shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating, or impregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing and shall comply with the requirements in paragraph (a)(1) of this section.

[2] A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

[3] M.D. means machine direction. C.D. means cross direction.

[4] A bleached sulphate kraft outer wall of 70 pounds basis weight will be permitted provided the combined test values of all of the 5 walls of the completed multiwall sack are in conformance with paragraph (e) of this section and § 178.238–3.

(2) Shipping sack, extensible kraft paper, plain:[1]

Nominal basis weight (500 sheets, 24" × 36")[2] (pounds)	Minimum dry tearing strength (grams)		Minimum tensile energy absorption ft./lbs. per square foot of paper	
	M.D.[3]	Total M.D. plus C.D.[3]	C.D.[3] [4]	Total C.D. plus M.D.[3] [4]
40	88	188	4.5	14.0
50	110	235	5.6	17.0
60	132	282	7.0	20.0
70	154	329	8.0	23.0
80	176	376	9.0	26.0

[1] Extensible shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching, creping, coating, spraying, laminating or inpregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing, and shall comply with the requirements in paragraph (a)(2) of this section.

[2] A tolerance of minus 10 percent of the basis weight of individual plies of extensible shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all; plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

[3] M.D. means machine direction. C.D. means cross direction.

[4] Variations in cross-direction tensile energy absorption of not more than 0.5 units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the machine-direction tearing strength in the ratio of twenty units of tearing strength to one unit of tensile energy absorption, and variations in total tensile energy absorption of not more than one unit below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tearing strength in the same ratio. Similarly, variations in machine direction tearing strength of not more than ten units below minimum requirements will be permitted, provided variations are compensated by an increased in cross-direction tensile energy absorption in the ratio of one unit of tensile energy absorption to twenty units of tearing strength; and variations in total tearing strength of not more than twenty units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tensile energy absorption in the same ratio. Conformance with the requirements of table shall be established by comparing the sum of the basis weights and tests for all of the plies specified in the construction of the bag, with the sum of the specified basis weights and tests for the respective papers comprising the different plies. All requirements in this table are for a paper conditioned to a relative humidity of 50 percent at a temperature of 23° C (73° F).

(b) Asphalt laminated or polyethylene coated shipping sack kraft paper when used shall comply with the following requirements:

Type paper	Minimum average dry tearing strength (grams)		Minimum average dry tensile strength per inch width (pounds)		Heat resistance hours at 150° F. without impairing function of sack	Maximum average water-vapor permeability from both sides at 50 percent R.H. and 73° F. g/m, 2/24 hours	
	M.D.	Total M.D. plus C.D.	C.D.	Total C.D. plus M.D.		Uncreased	Creased[1]
Asphalt laminated[2] [4]	110	235	19	53	5	9.0	15.0
15PE–50 1/50–10PE[3]	110	235	19	53	5	7.0	12.0
15PE–50 1/50–15PE[3]	110	235	19	53	5	4.5	7.5

[1] Creasing at 40° F.

[2] Asphalt laminated kraft paper when used as a wall in fabricated sacks, shall conform to the requirements of paragraph (b) of this section and shall consist of two sheets of kraft paper, the total basis weight of the two paper plies not less than 50 pounds per ream (500 sheets, 24" × 36"), continuously and uniformly laminated together with an average of not less than 25 pounds of asphalt per ream (500 sheets, 24" × 36"). Tolerance of minus 5 percent will be allowed on individual components. The total basis weight of the finished combination shall not exceed 100 pounds per ream (500 sheets, 24" × 36"). An asphalt laminated kraft wall meeting these requirements may be substituted for a plain kraft of 50 pounds basis or less, provided it meets the specification.

[3] Polyethylene-coated shipping sack kraft paper. The polyethylene-coated kraft paper when used as walls in fabricated sacks shall meet the heat resistance and water-vapor permeability requirements as specified in the table. A tolerance of minus 10 percent will be allowed for the lot sample average coating weight of polyethylene on shipping sack kraft paper. Minimum samples for testing shall comprise not less than 3 specimens 16 square inches each selected representatively from each polyethylene-coated wall of each sack in the lot sample. When barrier sheets are based on extensible kraft; the weight of the barrier material shall be in addition to the basis weight of the paper.

[4] Asphalt laminated extensible kraft paper must consist of two sheets of extensible kraft paper, the total basis weight of the paper in the finished combination being not less than 50 pounds per ream (24 × 36—500) with neither sheet weighing less than 23 pounds continuously and uniformly laminated together, with an average of not less than 25 pounds of asphalt per ream (24 × 36—500). In determining the basis weight and test conformance of bags containing an asphalt laminated extensible kraft wall, the asphalt laminated extensible kraft wall shall be treated as if it were a single extensible kraft wall or combination of walls of 10 pounds lower total paper basis weight than the sum of the nominal basis weight in the asphalt laminated wall, but in no case shall be treated as less than the equivalent of a 50 pounds basis weight wall.

(c) Laminating materials. Any laminant other than asphalt or other water-vapor barrier walls may be used provided they meet the strength requirements in paragraph (b) of this section.

(d) All values in paragraphs (a) and (b) of this section are for paper having a moisture content in equilibrium with an atmosphere having a relative humidity of 50 percent plus or minus 2 percent at a temperature of 73° F. plus or minus 3.5° F. following preconditioning of the test specimens to a moisture content between 3 and 3.5 percent by exposure to relatively dry air having a temperature no greater than 140° F.

(e) Conformance of sacks with paper strength requirements shall be established by comparing the sums of the test values for all the walls of the new and unused sack with the sums of the respective strength values specified in paragraphs (a) and (b) of this section for the respective papers specified for the different walls of the sack.

(1) Variation in cross direction dry tensile strength of not more than 2 units below the minimum requirements based on paragraphs (a) and (b) of this section will be permitted for each wall of the sack, provided the variation is compensated for by a machine direction tearing strength test value in excess of the minimum requirement obtained from the tables, in the ratio of 5 units of tearing strength for each unit of dry tensile strength test below the minimum requirement; and variation in combined dry tensile strength of not more than 4 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall used provided the variation is compensated for by a combined tearing strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of combined tearing strength for each unit of dry tensile strength test below the minimum requirement. Similarly, variation in machine direction tearing strength of not more than 10 units below the minimum requirement will be permitted for each wall, provided the variation is compensated for by a cross direction dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 1 unit of dry tensile strength for each 5 units of tearing strength test below the minimum requirement; and variation in combined tearing strength of not more than 20 units below the minimum requirement obtained from the tables will be permitted for each wall provided the variation is compensated for by a combined dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of tearing strength for each unit of dry tensile strength below the minimum requirement.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18966, Dec. 29, 1964, as amended by Order 66, 30 FR 5758, Apr. 23, 1965; Order 71, 31 FR 9082, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and further amended by Amdt. 178-59, 44 FR 66203, Nov. 19, 1979]

§ 178.238-3 Construction.

(a) Bags must be at least 5 thicknesses of paper; this must be heavy duty shipping sack kraft paper, conforming to the requirements of § 178.238-2 paragraphs (a) and (b), or equivalent, with a minimum total basis weight of 320 pounds of paper (500 sheets, 24″ × 36″). Outer sheet must be of water resistant stock and at least 70 pounds basis weight, inner sheets not less than 50 pounds basis weight. Bags to be of sewn, sift-proof bottom construction. Other bottoms of equal efficiency authorized.

NOTE 1: Exceptions to these construction requirements are authorized in §§ 173.367(a)(5) and 173.377(i) of this chapter.

(b) Moisture proof barrier sheets of paper, if used, must meet the strength requirements of § 178.238-2(b) and shall be counted as 50 pounds basis weight (500 sheets, 24 × 36 inches).

[29 FR 18966, Dec. 29, 1964, as amended by Order 67, 30 FR 7425, June 5, 1965; Order 71, 31 FR 9082, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967, and further amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.238-4 Adhesive.

(a) Moisture resistant adhesive must be used on all seams, joints, and bottom patch, if any.

§ 178.238-5 Closure.

(a) For all bags: Any closure for the top which is equal in efficiency to that of the bottom, is authorized.

§ 178.238-6 Tests for shipment.

(a) Bags as prepared for shipment must be able to withstand four 4-foot drops, one on each end and one each on opposite sides, without sifting or rupture.

§ 178.238-7 Marking.

(a) On each bag with letters and figures at least ½ inch high in rectangle as follows:

DOT-44D

(b) Each bag must also be marked with the name and address or symbol of the person making the mark specified in paragraph (a) of this section and be located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18966, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38183, Sept. 9, 1976]

§ 178.239 Specification 44E; multiwall paper bags.

§ 178.239-1 Compliance.

(a) Required in all details.

§ 178.239-2 Paper.

(a) Shipping sack kraft paper, plain, or extensible plain, shall conform to the average requirements specified in paragraphs (a)(1) or (2) of this section.

(1) Shipping sack, kraft paper, plain:[1]

Nominal basis weight (500 sheets, 24" × 36")[2] [4] (pounds)	Minimum average dry tearing strength (grams)		Minimum average dry tensile strength per inch width (pounds)	
	M.D.[3]	Total M.D. plus C.D.[3]	C.D.[3]	Total C.D. plus M.D.[3]
40	88	188	14	41
50	110	235	19	53
60	132	282	23	64
70	154	329	27	74

[1] Shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching (except as provided by footnote 4 of this table), creping, coating, spraying, laminating, or impregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing and shall comply with the requirements in paragraph (a)(1) of this section.

[2] A tolerance of minus 10 percent of the basis weight of individual plies of plain shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basic weight will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied, such as coating or printing.

[3] M.D. means machine direction. C.D. means cross direction.

[4] A bleached sulphate kraft outer sheet of not less than 50 pounds basis weight is authorized providing the combined test values of all of the sheets of the bag are in conformance with paragraph (e) of this section and § 178.239-3.

(2) Shipping sack, extensible kraft paper plain.[1]

Nominal basis weight (500 sheets, 24" × 36")[2] [4] (pounds)	Minimum dry tearing strength (grams)		Minimum tensile energy absorption ft./lbs. per square foot of paper[3]	
	M.D.[3]	Total M.D. plus C.D.[3]	C.D.[3]	Total C.D. plus M.D.[3]
40	88	188	4.5	14.0
50	110	235	5.6	17.0
60	132	282	7.0	20.0
70	154	329	8.0	23.0
80	176	376	9.0	26.0

[1] Extensible shipping sack kraft paper, plain, is paper that consists of all sulphate pulp and no other fiber, and which has not been treated by coloring, bleaching (except as provided by Footnote 4 of this table), creping, coating, spraying, laminating or impregnating for special qualities. Paper shall have a degree of water resistance as secured by normal rosin sizing, and shall comply with the requirements in paragraph (a) (2) of this section.

[2] A tolerance of minus 10 percent of the basis weight of individual plies of extensible shipping sack kraft paper will be permitted; an average tolerance of minus 5 percent will be permitted in the sum total basis weight of all plies in multiwall constructions. Variations in excess of specified basis weights will not be considered a defect or deviation. The basis weight of paper means the basis weight as produced by the paper machine, not including finish subsequently applied such as coating or printing.

[3] M.D. means machine direction. C.D. means cross direction.

[4] A bleached sulphate extensible kraft outer sheet of not less than 50 pounds basis weight is authorized providing the combined test values of all the sheets of the bag are in

conformance with paragraph (e) of this section and § 178.239-3.

[5] Variations in cross-direction tensile energy absorption of not more than 0.5 units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the machine- direction tearing strength in the ratio of twenty units of tearing strength to one unit of tensile energy absorption, and variations in total tensile energy absorption of not more than one unit below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tearing strength in the same ratio. Similarly, variations in machine-direction tearing strength of not more than ten units below minimum requirements will be permitted, provided variations are compensated by an increase in cross-direction tensile energy absorption in the ratio of one unit of tensile energy absorption to twenty units of tearing strength; and variations in total tearing strength of not more than twenty units below the minimum requirements will be permitted, provided the variations are compensated by an increase in the total tensile energy absorption in the same ratio. Conformance with the requirements of the Table shall be established by comparing the sum of the basis weights and tests for all of the plies specified in the construction of the bag, with the sum of the specified basis weights and tests for the respective papers comprising the different plies. All requirements in this table are for a paper conditioned to a relative humidity of 50 percent at a temperature of 23° C (73° F).

(b) Asphalt laminated or polyethylene coated shipping sack kraft paper when used shall comply with the following requirements:

Type paper	Minimum average dry tearing strength (grams)		Minimum average dry tensile strength per inch width (pounds)		Heat resistance hours at 150° F. without impairing function of sack	Maximum average water-vapor permeability from both sides at 50 percent R.H. and 73° F. g/m, 2/24 hours	
	M.D.	Total M.D. plus C.D.	C.D.	Total C.D. plus M.D.		Uncreased	Creased[1]
Asphalt laminated[2] [4]	110	235	19	53	5	9.0	15.0
10PE-50 1/50-10PE[3]	110	235	19	53	5	7.0	12.0
15PE-50 1/50-15PE[3]	110	235	19	53	5	4.5	7.5

[1] Creasing at 40° F.

[2] Asphalt laminated kraft paper when used as a wall in fabricated sacks, shall conform to the requirements of paragraph (b) of this section and shall consist of two sheets of kraft paper, the total basis weight of the two paper plies not less than 50 pounds per ream (500 sheets, 24" × 36"), continuously and uniformly laminated together with an average of not less than 25 pounds of asphalt per ream (500 sheets, 24" × 36"). Tolerance of minus 5 percent will be allowed on individual components. The total basis weight of the finished combination shall not exceed 100 pounds per ream (500 sheets, 24" × 36"). An asphalt laminated kraft wall meeting these requirements may be substituted for a plain kraft wall of 50 pounds basis or less, provided it meets the specification.

[3] Polyethylene-coated shipping sack kraft paper. The polyethylene-coated kraft paper when used as walls in fabricated sacks shall meet the heat resistance and water-vapor permeability requirements as specified in the table. A tolerance of minus 10 percent will be allowed for the lot sample average coating weight of polyethylene on shipping sack kraft paper. Minimum samples for testing shall comprise not less than 3 specimens 16 square inches each selected representatively from each polyethylene-coated wall of each sack in the lot sample. When barrier sheets are based on extensible kraft the weight of the barrier material shall be in addition to the basis weight of the paper.

[4] Asphalt laminated extensible kraft paper must consist of two sheets of extensible kraft paper, the total basis weight of the paper in the finished combination being not less than 50 pounds per ream (24 × 36—500) with neither sheet weighting less than 23 pounds continuously and uniformly laminated together, with an average of not less than 25 pounds of asphalt per ream (24 × 36—500). In determining the basis weight and test conformance of bags containing an asphalt laminated extensible kraft wall, the asphalt laminated extensible kraft wall shall be treated as if it were a single extensible kraft wall or combination of walls of 10 pounds lower total paper basis weight than the sum of the nominal basis weight in the asphalt laminated wall, but in no case shall be treated as less than the equivalent of a 50 pounds basis weight wall.

(c) Laminating materials: Any laminant other than asphalt or other water-vapor barrier walls may be used provided they meet the requirements in paragraph (b) of this section.

(d) All values in paragraphs (a) and (b) of this section are for paper having a moisture content in equilibrium with an atmosphere having a relative humidity of 50 percent plus or minus 2 percent at a temperature of 73° F. plus or minus 3.5° F. following preconditioning of the test specimens to a moisture content between 3 and 5.5 percent by exposure to relatively dry air having a temperature no greater than 140° F.

(e) Conformance of sacks with paper strength requirements shall be established by comparing the sums of the test values for all the walls of the new and unused sack with the sums of the respective strength values specified in paragraphs (a) and (b) of this section for the respective papers specified for the different walls of the sack.

(1) Variation in cross direction dry tensile strength of not more than 2 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall of the sack, provided the variation is compensated for by a machine direction tearing strength test value in excess of the minimum requirement obtained from the tables, in the ratio of 5 units of tearing strength for each unit of dry tensile strength test below

the minimum requirement; and variation in combined dry tensile strength of not more than 4 units below the minimum requirement based on paragraphs (a) and (b) of this section will be permitted for each wall used provided the variation is compensated for by a combined tearing strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of combined tearing strength for each unit of dry tensile strength test below the minimum requirement. Similarly, variation in machine direction tearing strength of not more than 10 units below the minimum requirement will be permitted for each wall, provided the variation is compensated for by a cross direction dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 1 unit of dry tensile strength for each 5 units of tearing strength test below the minimum requirement; and variation in combined tearing strength of not more than 20 units below the minimum requirement obtained from the tables will be permitted for each wall provided the variation is compensated for by a combined dry tensile strength test value in excess of the minimum requirement obtained from the tables in the ratio of 5 units of tearing strength for each unit of dry tensile strength below the minimum requirement.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18966, Dec. 29, 1964, as amended by Order 66, 30 FR 5758, Apr. 23, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and further amended by Amdt. 178-59, 44 FR 66203, Nov. 19, 1979]

§ 178.239-3 Construction and capacity.

(a) Bags must be at least 3 thicknesses of paper; this must be heavy duty shipping sack kraft paper conforming to the requirements of § 178.239-2 paragraphs (a) and (b), or equivalent, with a minimum total basis weight of 130 pounds of paper (500 sheets, 24″ × 36″). Outer sheet must be of water-resistant stock and at least 50 pounds basis weight, inner sheet not less than 40 pounds basis weight. Bags to be of sewn and taped, cemented, taped, satchel bottom or other construction of equal efficiency to form a sift-proof and reasonably airtight container. Authorized for not over 50 pounds net weight, except that bags having a minimum total basis weight of 160 pounds of paper (500 sheets 24″ × 36″) with outer sheet of water-resistant stock and at least 60 pounds basis weight inner sheets not less than 50 pounds basis weight, are authorized for not to exceed 100 pounds net weight of contents.

(b) Moisture proof barrier sheets of paper, if used, must meet the requirements of § 178.239-2(b) and shall be considered as one thickness of paper and shall be counted as 50 pounds basis weight (500 sheets, 24″ × 36″).

§ 178.239-4 Adhesive.

(a) Moisture resistant adhesive must be used on all seams, joints, and bottom patch, if any.

§ 178.239-5 Closure.

(a) For all bags: Any closure for the top which is equal in efficiency to that of the bottom, is authorized.

§ 178.239-6 Tests for shipment.

(a) Bags as prepared for shipment must be able to withstand four 4-foot drops, one on each end and one each on opposite sides, without sifting or rupture.

§ 178.239-7 Marking.

(a) On each bag with letters and figures at least ½ inch high in rectangle as follows:

DOT-44E

(b) Each bag must also be marked with the name and address or symbol of the person making the mark specified in paragraph (a) of this section and be located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18966, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38183, Sept. 9, 1976]

§ 178.240 Specification 45B; bags, cloth and paper, lined.

§ 178.240-1 Compliance.

(a) Required in all details.

§ 178.240-2 Capacity.

(a) Not over 100 pounds net.

§ 178.240-3 Assembly.

(a) Bags shall consist of cloth and paper parts all cemented together with curing rubber latex or asphalt, thus making a waterproofed bag as follows:

(1) Inside lining sheet.
(2) Cloth sheet.
(3) Intermediate sheet.
(4) Outside paper sheet.

§ 178.240-4 Inside lining sheet and intermediate sheet.

(a) Inside lining sheet and intermediate sheet must be regenerated cellulose film at least 0.0012 inch thick or polyvinyl alcohol film at least 0.001 inch thick or other material of equal thickness and equivalent efficiency.

§ 178.240-5 Cloth sheet.

(a) Cloth sheet must be burlap at least 8-ounce, 40-inch Calcutta A or B mill grade or Osnaburg cotton cloth at least 8½ ounces per square yard.

§ 178.240-6 Paper.

(a) Paper must be shipping sack Kraft, creped, at least 45 pounds per ream (500 sheets 24″ × 36″) before creping.

§ 178.240-7 Latex and asphalt.

(a) Latex and asphalt must be in sufficient quantity to form a secure bond between the parts of the bags.

§ 178.240-8 Seams.

(a) Seams must be dust-tight and made by cementing or by sewing and taping with impregnated cloth tape to give seam strength at least equal to that of bag material and prevent sifting.

§ 178.240-9 Test.

(a) The finished container, filled and closed as for shipment, must be capable of withstanding 2 drop tests of 6 feet on the butt and 2 drop tests of 6 feet on the side without sifting or rupture of burlap or liner.

§ 178.240-10 Marking.

(a) Marking on each container by marks at least 1 inch high as follows:

(1) DOT-45B.

(2) Name and address or symbol of person making the mark specified in paragraph (a)(1) of this section and located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[29 FR 18966, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-40, 41 FR 38182, Sept. 9, 1976]

§ 178.240-11 Closing for shipment.

(a) By sewing and taping with impregnated cloth tape to give seam strength at least equal to that of bag material and prevent sifting.

§ 178.241 Specification 44P; all-plastic bags.

[Order 71, 31 FR 9082, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.241-1 Compliance.

(a) Required in all details.

[Order 71, 31 FR 9082, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.241-2 Plastic.

(a) Plastic film shall be low density polyethylene having a melt index of 0.6 maximum, conforming to the minimum requirements specified in subparagraph (a)(1) of this section.

(1) Plastic film:

Nominal gauge (mils) [1]	Drop dart (grams) [2]	Lbs. per square inch tensile [3]	Percent elongation [3]	Tear (grams) [4]
5	210	2,100	350	200
6	250	2,100	350	240
7	295	2,100	350	280
8	340	2,100	350	350

[1] Gauge as measured by ASTM D 374-57T; tolerance ±10 percent.

[2] Drop dart as measured by the drop dart method (ASTM D 1709-62T Method B). Under this method a polished steel dart having a diameter of 2 inches in the hemispherical head is suspended by an electro-magnet at a height sufficient to provide a drop of 60 inches to the surface of the test specimen. The test specimen must be placed over the bottom part of a 2-piece annual clamp having an inside diameter of 5 inches, so as to be uniformly flat and free of folds. Test specimen must cover the clamp at all points. Not

less than 10 specimens, not more than one drop per specimen, must be tested. If one-half or more of the specimens tested resist failure the film shall be deemed to meet the requirements. Failure is defined as any break through the film.

[3] Tensile and percent elongation as measured by ASTM D 882-61T Method A.

[4] Tear as measured by ASTM D 1922-61T.

[Order 71, 31 FR 9082, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.241-3 Construction and capacity.

(a) Bags must be constructed of plastic film conforming to the requirements of § 178.241-2. Bags having heat-sealed ends must be capable of withstanding static loads of 1¼ pounds per mill per inch of seal as measured in the following manner. Three 1-inch wide samples must be cut from the top seal and 3 1-inch wide samples must be cut from the bottom seal of each bag to be tested. Samples must be cut perpendicular to the seal, one from the center of the seal and one each approximately 4 inches in each direction from the center of the seal. (The preferred method of cutting the samples is to place a 1-inch wide die on the flat bag so that both film layers and the seal area can be cut simultaneously). Samples must be cut of sufficient length to permit wrapping each film end around a ¼-inch diameter metal rod and to permit clamping each end 1 inch from heat seal. Clamp used (such as a laboratory tubing clamp) must be one that will exert even pressure across a 1-inch wide strip. Clamps must be carefully positioned on strips parallel to the heat seals. One clamp must be mounted to a support, permitting the sample strip to hang vertically, and a weight must be attached to the other clamp hanging free at the lower end of the assembly. The total weight exerted on the seal must be 1¼ pounds for each mill of gauge of the film. The test must be conducted at room temperature (approximately 73° F.). All samples tested must resist failure. Failure is defined as total seal separation occurring within 10 minutes after the test has begun. Other end closures of equal efficiency authorized. Bags of not less than 5-mil construction authorized for contents not to exceed 51 pounds net weight. Bags of not less than 7-mil construction authorized for contents not to exceed 81 pounds net weight.

[Order 71, 31 FR 9082, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.241-4 Tests for shipment.

(a) Bags as prepared for shipment must be able to withstand six drops from a height of 4 feet onto a solid surface, one drop on each end, one drop on each face, and one drop on each side (edge), without sifting or rupture.

[Order 71, 31 FR 9082, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.241-5 Marking.

(a) Each bag must be marked with letters and figures at least ½ inch high in rectangle as follows:

(1) DOT-44P.

(2) This marking shall be enclosed by a rectangle.

(b) Each bag must also be marked with the name and address or symbol of the person making the mark specified in paragraph (a) of this section and be located just above or below that mark. Symbol, if used, must be registered with the Associate Director for OE.

[Amdt. 178-40, 41 FR 38183, Sept. 9, 1976]

Subpart H—Specifications for Portable Tanks

Source: 29 FR 18972, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§ 178.245 Specification 51; steel portable tanks.

§ 178.245-1 Requirements for design and construction.

(a) Tanks must be of seamless or welded steel construction or combination of both and must have in excess of 1,000 pounds water capacity. Fusion welded tanks must be postweld heat treated and radiographed to provide the highest joint efficiency provided by the ASME Code. Tanks must be designed and constructed in accordance with and fulfill the requirements of the ASME Code. Tanks constructed in accordance with the requirements of Part UHT of the ASME Code must comply with the following additional requirements:

(1) Welding procedure and welder performance tests must be made annually in accordance with section IX of the ASME Code. In addition to the essential variables named therein the following must be considered to be essential variables: Number of passes, thickness of plate, heat input per pass, and manufacturer's identification of rod and flux. The number of passes, thickness of plate and heat input per pass may not vary more than 25 percent from the procedure qualification. Records of the qualification must be retained for at least 5 years by the tank manufacturer and made available to duly identified representatives of the Department of Transportation or the owner of the tank.

(2) Impact tests must be made on a lot basis. A lot is defined as 100 tons or less of the same heat and having a thickness variation no greater than plus or minus 25 percent. The minimum impact required for full-sized specimens shall be 20 foot-pounds (or 10 foot-pounds for half-sized specimens) at 0° F. Charpy V-Notch in both the longitudinal and transverse direction. If the lot test does not pass this requirement, individual plates may be accepted if they individually meet this impact requirement.

(b) Except as noted below, all openings in the tank shall be grouped in one location, either at the top of the tank or at one end of the tank.

Exceptions: (1) The openings for liquid level gauging devices, or for safety devices, may be installed separately at the other location or in the side of the shell; (2) one plugged opening of 2-inch National Pipe Thread or less provided for maintenance purposes may be located elsewhere; (3) an opening of 3-inch National Pipe Size or less may be provided at another location, when necessary, to facilitate installation of condensing coils.

(c) Each uninsulated tank used for the transportation of compressed gas, as defined in § 173.300 of this subchapter, must have an exterior surface finish that is significantly reflective such as a light reflecting color if painted, or a bright reflective metal or other material if unpainted.

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18249, Nov. 14, 1969; Amdt. 178-33, 39 FR 17320, May 15, 1974]

§ 178.245-2 Material.

(a) All material used for the construction of the tank and appurtenances shall be suitable for use with the commodity to be transported therein.

(b) A material of thickness less than 3/16 inch shall not be used for the shells and heads.

§ 178.245-3 Design pressure.

(a) The design pressure of a tank authorized under this specification shall be not less than the vapor pressure of the commodity contained therein at 115° F., or as prescribed for a particular commodity by Part 173 of this chapter, except that in no case shall the design pressure of any container be less than 100 psig or more than 500 psig. When corrosion factor is prescribed by these regulations, the wall thickness of the tank calculated in accordance with the "Code" (see § 178.245-1(a)) shall be increased by 20 percent or 0.10 inch, whichever is less.

NOTE 1: The term "design pressure" as used in this specification is identical to the term "maximum allowable working pressure" as used in the "Code" (see § 178.245-1(a)).

§ 178.245-4 Tank mountings.

(a) Tanks shall be designed and fabricated with mountings to provide a secure base in transit. "Skids" or similar devices shall be deemed to comply with this requirement.

(b) All tank mountings such as skids, fastenings, brackets, cradles, lifting lugs, etc., intended to carry loadings shall be permanently secured to tanks in accordance with the requirements of the Code under which the tanks were fabricated and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used. The specific gravity used in determining the static loadings shall be shown on the marking required by

§ 178.245-6(a) and on the report required by § 178.245-7(a).

(c) Lifting lugs or hold-down lugs may be added to either the tank or tank mountings. If lifting lugs and hold-down lugs are added directly to the tank, they shall be secured to doubling plates welded to the tank and located at points of support, except that lifting lugs or hold-down lugs with integral bases serving as doubling plates may be welded directly to the tank. Each lifting lug and hold-down lug shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used.

(d) All tank mountings shall be designed so as to prevent the concentration of excessive loads on the tank shell.

§ 178.245-5 Protection of valves and accessories.

(a) All valves, fittings, accessories, safety devices, gaging devices, and the like shall be adequately protected against mechanical damage.

(b) The protective device or housing shall comply with the requirements under which the tanks are fabricated with respect to design and construction, and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the lading using a safety factor of not less than four, based on the ultimate strength of the material to be used.

(c) Requirements concerning types of valves, retesting, and qualification of portable tanks contained in §§ 173.32 and 173.315 of this chapter must be observed.

§ 178.245-6 Name plate.

(a) In addition to the markings required by the Code (see § 178.245-1(a)) under which tanks were constructed, they shall have permanently affixed, on one of the heads of the tank, a metal plate. This plate shall be permanently affixed by means of soldering, brazing, or welding around its complete perimeter. Neither the plate itself nor the means of attachment to the tank shall be subject to destructive attack by the contents of tank. Upon such plate shall be plainly marked by stamping, embossing, or other means of forming, letters into or onto the metal of the plate itself the following information in characters at least ⅜ inch high:

Manufacturer's name ——————
Serial No. —— Owner's serial No. ——
D.O.T. Specification No. ——————
Water capacity (pounds) ——————
Tare weight (pounds) ——————
Design pressure (psig) ——————
Design specific gravity ——————
Original test date ——————
Tank retested at —— (psig) on ——

(b) All tank outlets and inlets, except safety relief valves, shall be marked to designate whether they communicate with vapor or liquid when the tank is filled to the maximum permitted filling density.

§ 178.245-7 Report.

(a) A copy of the manufacturer's data report required by the Code (see § 178.245-1(a)) under which the tank is fabricated shall be furnished for each new tank to the owner and the Associate Director for OE. In addition, the manufacturer or owner shall register each tank with the Bureau of Explosives in the following form:

Place ——————
Date ——————
Portable tank
Manufactured by —————— Company
Location ——————
Manufactured by —————— Company
Location ——————
Consigned to —————— Company
Location ——————
Size —— feet outside diameter by —— long

Marks on tank as prescribed by § 178.245-6 of this specification are as follows:

Manufacturer's name ——————
Serial No. —— ——————
Owner's serial No. —— ——————
D.O.T. Specification No. ——————
Date of manufacture ——————
Water capacity (pounds) ——————
Tare weight (pounds) ——————
Design pressure (psig) ——————
Design specific gravity ——————

It is hereby certified that this tank is in complete compliance with the requirements, of DOT Specification No. 51.

(Signed) ——————
(Manufacturer or owner)

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-51, 43 FR 48645, Oct. 19, 1978]

§ 178.251 General design and construction requirements applicable to specifications 56 (§ 178.252) and 57 portable tanks (§ 178.253).

§ 178.251-1 General requirements.

(a) These specifications apply to tanks of any shape (cylindrical, conical, cubical, or other).

(b) The rated gross weight of the tank must not exceed the values used during the design qualification vibration and drop tests.

(c) Each tank must be in compliance with all applicable requirements of §§ 173.24 and 173.32 of this chapter.

[Amdt. 178-60, 37 FR 2887, Feb. 9, 1972]

§ 178.251-2 Materials of construction.

(a) Except for gaskets, pressure relief devices, valve seats, liners, and linings, all construction material must be metal.

(b) Hardware for handling and securing, fitting protection, outlet piping, valves, relief devices, and closures must be made of material that is electrolytically compatible with, or suitably protected from electrolytic action when joined to the product retention components of the tank.

(c) Any material used must not be susceptible to stress corrosion cracking.

(d) Material specification: All sheet, plate, and extruded material for shell, heads, bulkheads, and baffles for portable tanks must meet the following minimum requirements:

(1) *Aluminum alloys.* Aluminum alloys must be suitable for fusion welding and must meet the following requirements:

Minimum yield strength	24,000 p.s.i.
Minimum ultimate strength	30,000 p.s.i.
Minimum elongation of standard 2 inch gage length.	8 percent.

(2) *Steel.* Steel must meet the following requirements:

	Mild steel	Low alloy low carbon	Stainless
Minimum yield strength, p.s.i.	25,000	45,000	25,000
Minimum ultimate strength, p.s.i	45,000	60,000	70,000
Minimum elongation of standard 2 inch gage length (percent)	20	25	30

(3) *Magnesium alloys.* Magnesium alloy must conform to ASTM B-90-69, Grade ZE-10A.

[Amdt. 178-60, 37 FR 2887, Feb. 9, 1972]

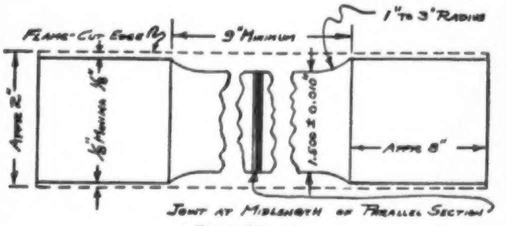
§ 178.251-3 General construction requirements.

(a) *Method of joining.* All joints between tank shells, heads, baffles (or baffle attaching rings), and bulkheads must be welded in accordance with the requirements of this section.

(b) *Strength of joints (Aluminum Alloy (AL), Magnesium Alloy (MG)).* All welded joints must be made in accordance with recognized good practice. The efficiency of a joint must not be less than 85 percent of the mechanical properties of the adjacent material. Each alloy must be joined by an inert gas arc welding process using filler metals which are consistent with material suppliers recommendations.

(c) *Strength of joints (Mild Steel (MS), High Strength Low Alloy (HSLA), Austenitic Stainless Steel (SS)).* Joints must be welded in accordance with recognized good practice. The efficiency of any joint must not be less than 85 percent of the mechanical properties of the adjacent material.

(d) *Compliance test.* Compliance with the requirements contained in paragraph (b) or (c) of this section for the welded joints must be determined by preparing two test specimens from materials representative of those to be used in each tank. Joints must be made by the same technique of fabrication and must conform to the figure below. Each specimen must be tested to failure under tension. One pair of test specimens may represent all the tanks to be made of the same combination of materials by the same technique of fabrication, and in the same shop, within 6 months after the tests on such samples have been completed. The butt welded specimens tested may be considered as qualifying other types or combinations of types of weld using the same filler material and welding process as long as parent metals are of the same types of material.



TENSILE SPECIMEN

[Amdt. 178-60, 37 FR 2887, Feb. 9, 1972]

§ 178.251-4 Stacking, mounting, and tie-down provisions.

(a) *Load support devices.* Each tank designed to be stacked in storage must be provided with load support devices. There may be no significant permanent deformation of the load support devices or the tank under either of the following stress conditions:

(1) Tanks loaded to their maximum authorized gross weight and stacked at least 18 feet high.

(2) A load on the support devices at least three times the maximum authorized gross weight of the tank.

(b) *Base mounting.* Each tank must be constructed with mountings to provide a secure base during transportation. The mounting may be in the form of a skid or similar structure.

(c) *Tie-down system.* If there are tie-down devices that are a structural part of the tank, the tie-down system must be capable of withstanding the following static loading without significant deformation to the tank. The static loading applied must have, with respect to the center of gravity of the tank a vertical component of at least two times the maximum authorized gross weight of the tank.

(1) If the design of the tank necessitates specific front and side orientation when loaded on a transportation vehicle, the static loading applied must have two horizontal components at right angles to each other, one direction at a time as follows:

(i) A longitudinal component at least seven times the maximum authorized gross weight of the tank in the direction of travel of the vehicle, and

(ii) A component of five times the maximum authorized gross weight of the tank in the transverse direction, or

(2) If the design of the tank does not necessitate specific front and side orientation when loaded on a transportation vehicle, the static loading applied must have two horizontal components at right angles to each other, one direction at a time, of at least seven times the maximum authorized gross weight of the tank.

(d) If there is a structural part of the tank that could be used to tie the tank down and which is not in compliance with paragraph (c) of this section, it must be securely covered or locked during transportation to prevent its use as a tie-down.

[Amdt. 178-60, 37 FR 2887, Feb. 9, 1972]

§ 178.251-5 Testing.

(a) *Design qualification testing.* Design qualification tests prescribed in this paragraph must be made on at least one of each design and size tank, except that a set of tests, when made on a tank of one size, may serve to qualify smaller tanks made of same kind and thickness of materials, by the same fabrication technique, and with identical supports, and equivalent closures, and other appurtenances. Tests must be performed sequentially on a single tank in the order listed in this section. Additional tests must be made if there is any increase in design size of the tank, any reduction in thickness of material, or any change in material, or in fabrication technique. Test samples must be retained for 1 year.

(1) *Vibration and drop tests.* See applicable specification, § 178.252-3(a) or § 178.253-5(a).

(2) *Structural integrity tests*—(i) *Lifting devices.* If there is a system of lifting devices that is a structural part of the tank or is permanently attached thereto or to the support structure, the system must be capable of supporting at least three times the maximum gross weight of the tank, and

each individual lifting devices must be capable of supporting at least the maximum gross weight of the tank, without significant permanent deformation in either the lifting device system or in any part of the tank.

(ii) *Shipment support structure.* If the tank supports are a structural part of the tank, the supports must be capable of absorbing a force equal to the maximum gross weight of the tank or breaking without significant permanent deformation to the product retention component of the tank. The force must be applied to the supports at ground level from at least two horizontal directions at right angles to each other, one direction at a time.

(iii) *Stacking support devices.* If stacking support devices are a structural part of the tank, there must be no significant permanent deformation of any device or the tank under either of the following stress conditions:

(*a*) Tanks loaded to their maximum authorized gross weight and stacked at least 18 feet high.

(*b*) A load on the stacking support devices of at least three times the maximum authorized gross weight of the tank.

(iv) *Fittings and protective devices.* Each fitting (or its protective device) subject to this test requirement must be capable of withstanding a force at least two times the maximum authorized gross weight of the tank without resultant damage to the fitting. The force must be applied to the fitting or its protective device in at least two horizontal directions at right angles to each other, one direction at a time, and in alinement with the fitting.

(b) *Production quality control, testing and inspection.* See applicable specification, § 178.252-3(b) or § 178.253-5(b).

[Amdt. 178-60, 37 FR 2887, Feb. 9, 1972]

§ 178.251-6 Rejected tanks.

No tank which fails to pass any of the prescribed tests may be placed in service until suitable repairs have been made and satisfactory re-tests results have been obtained.

[Amdt. 178-60, 37 FR 2887, Feb. 9, 1972]

§ 178.251-7 Identification and marking.

(a) A metal certification plate must be permanently affixed to each tank and must be readily accessible for inspection. The plate must be marked in letters and numerals at least ⅜-inch high by stamping, embossing, or other means of forming letters into or on the metal plate itself. The marking must contain at least the following information:

Tank manufacturer ______
Specification identification: Spec. 56 or Spec. 57 ______
Design pressure (*for specification 57 only*) ______ p.s.i.g.
Test pressure (*for specification 56 only*) ______ p.s.i.g.
Serial number ______
Original test date ______
Tare weight ______ lbs.
Rated gross weight[1] ______lbs.
Volumetric capacity — U.S. gal. (or cu. ft.)
Materials of construction[2] ______

[1] The rated (permitted) gross weight may not exceed that weight used during the design qualification tests involving vibration and drop.

[2] E.g., AL for aluminum, MG for magnesium alloy, MS for mild steel, HSLA for high strength low alloy, SS for austenitic stainless steel, including ASTM or ASME reference.

(b) Unless the tank has been designed for stacking and meets the appropriate stacking integrity requirements of this specification, it must also be marked in letters at least 2 inches high in contrasting colors "Do Not Stack" and "Do Not Place Other Freight On Top Of This Tank", on at least two sides of the tank. These instructions must also appear on the certification plate. Plate markings are required to meet the requirements of paragraph (a) of this section and need not be in contrasting color.

[Amdt. 178-60, 37 FR 2887, Feb. 9, 1972]

§ 178.252 Specification 56; metal portable tank.

§ 178.252-1 General requirements.

(a) Each tank must be in compliance with the general design and construction requirements in § 178.251 in addition to the specific requirements of this section.

(b) Each tank may not exceed a rated gross weight of 7,700 pounds.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-60, 37 FR 2888, Feb. 9, 1972, as amended by Amdt. 178-58, 44 FR 60102, Oct. 18, 1979]

§ 178.252-2 Openings.

(a) Each fill and discharge opening must be equipped with a closure and locking device.

(b) A drum-type locking ring closure is authorized for openings not exceeding 23 inches in diameter. A drum-type locking ring closure must be at least a 12-gage bolted ring with forged lugs having at least a ⅝-inch steel bolt tapped into one of the lugs. The locking ring must be equipped with a lock nut or equivalent device.

(c) For a tank that incorporates a hopper-type product discharge opening, the closure device must be constructed to retain product under the test conditions outlined in §§ 178.251-5 and 178.252-3(a). Closures for those openings must be designed with positive mechanical locking and sealing devices to prevent leakage during normal conditions incident to transportation.

[Amdt. 178-60, 37 FR 2888, Feb. 9, 1972]

§ 178.252-3 Testing.

(a) *Design qualification testing.* In addition to the testing prescribed in § 178.252-5(a), a vibration and a drop test are also required on each design. For these tests, the tank must be filled with a fine, dry powdered material having a density that results in the tank having a gross weight not less than the rated gross weight of the tank.

(1) *Vibration test.* This test must be performed for 1 hour using a minimum double amplitude of 1 inch at a frequency that causes the test tank to be raised from the floor of the testing table so a piece of flat steel strap may be passed between the tank and the table. The tank must be restrained so that all horizontal motion is restricted and only vertical motion is permitted.

(2) *Drop test.* The tank must be capable of withstanding without leakage of contents of 2-foot free drop onto a flat unyielding horizontal surface, striking the target surface in the position and attitude from which maximum damage to the tank (including closures) is expected.

(b) *Production quality control, testing, and inspection*—(1) *Leakage test.* Each tank must be tested by a minimum air or hydrostatic pressure of at least 2 pounds per square inch gage applied to the entire tank. If the air pressure is used, the entire surface of all joints under pressure must be coated with, or immersed in, a solution of soap and water, or other material suitable for the purpose of detecting leaks. If the hydrostatic pressure test is used it must be carried out by using water or other liquid having a similar viscosity, the temperature of which may not exceed 100° F. and all joints under pressure must be inspected for leaks. For either test, the pressure must be held for a period of time sufficiently long to assure detection of leaks. All closures must be in place during the test. Any tank that has detectable leakage or significant permanent deformation does not meet the requirements of this specification.

[Amdt. 178-60, 37 FR 2888, Feb. 9, 1972]

§ 178.253 Specification 57; metal portable tank.

§ 178.253-1 General requirements.

(a) Each tank must be in compliance with the general design and construction requirements in § 178.251 in addition to the specific requirements of this section.

(b) Each tank must have a capacity of at least 110 gallons but not more than 660 gallons.

[Amdt. 178-60, 37 FR 2888, Feb. 9, 1972]

§ 178.253-2 Openings.

(a) Each fill and discharge opening must be equipped with a closure device that meets the following requirements:

(1) Any closure for a fill opening in excess of 20 square inches must be equipped with a device to prevent the closure from fully opening without first relieving internal pressure.

(2) Any product discharge valve, if used, must be provided with a leak tight device, such as a cap or plug.

(3) Each closure must be vapor tight.

(b) A drum-type locking ring closure is authorized for any opening less than 23 inches in diameter. A drum-type locking ring closure must be at least a 12-gage bolted ring with forged lugs having at least a ⅝-inch steel bolt tapped into one of the lugs. The locking ring must be equipped with a lock nut or equivalent device.

[Amdt. 178-60, 37 FR 2888, Feb. 9, 1972]

§ 178.253-3 Protection of fittings.

Each fitting which could be damaged sufficiently to result in leakage of tank contents must be protected by suitable guards or protective housings. The term "fitting" includes valves, closure devices, safety relief devices, and other accessories through which contents could leak from the tank. Each fitting or fitting protection device must be capable of withstanding the fitting protection test specified in § 178.251-5.

[Amdt. 178-60, 37 FR 2888, Feb. 9, 1972]

§ 178.253-4 Vents.

(a) Each tank must be equipped with at least one pressure relief device such as a spring-loaded valve, frangible disc or fusible plug.

(b) Each pressure relief device must communicate with the vapor space of the tank when the tank is in a normal transportation attitude. Shutoff valves must not be installed between the tank opening and any pressure relief device. Pressure relief devices must be mounted, shielded, or drained to prevent the accumulation of any material that could impair the operation or discharge capability of the device.

(c) The total emergency venting capacity (cu. ft./hr.) of each portable tank must be at least that determined from the following table.

Total surface area square feet [1] [2]	Cubic feet free air per hour
20	15,800
30	23,700
40	31,600
50	39,500
60	47,400
70	55,300
80	63,300
90	71,200
100	79,100
120	94,900
140	110,700
160	126,500

[1] Interpolate for intermediate sizes.

[2] Surface area excludes area of legs.

(1) The pressure operated relief device must open at not less than 3 pounds per square inch gage and at not over the design test pressure of the tank. The minimum venting capacity for pressure activated vents must be 6,000 cubic feet of free air per hour (measured at 14.7 p.s.i.a. and 60° F.) at not more than 5 pounds per square inch gage.

(2) If a frangible device is used for relieving pressure, the device must have a minimum area of 1.25 square inches and must be rated at less than the design test pressure of the tank.

(3) If a fusible device is used for relieving pressure, the device must have a minimum area of 1.25 square inches. The device must function at a temperature between 220° F. and 300° F. and at a pressure less than the design test pressure of the tank, unless this latter function is accomplished by a separate device.

(d) No relief device may be used which would release flammable vapors under normal conditions of transportation (temperature up to and including 130° F.).

[Amdt. 178-60, 37 FR 2888, Feb. 9, 1972]

§ 178.253-5 Testing.

(a) *Design qualification testing.* In addition to the testing prescribed in § 178.251-5, a vibration test, a drop test, and a pressure test are also required on each design. For the vibration and drop tests, the tank must be filled with a liquid to not less than the rated gross weight.

(1) *Vibration test.* This test must be performed for 1 hour using a minimum double amplitude of 1 inch at a frequency that causes the test tank to be raised from the floor of the testing table so a piece of flat steel strap may be passed between the tank and the table. The tank must be restrained so

that all horizontal motion is restricted and only vertical motion is permitted.

(2) *Drop test.* The tank must be capable of withstanding without leakage of contents a 2-foot free drop onto a flat unyielding horizontal surface, striking the target surface in the position and attitude from which maximum damage to the tank (including piping and fittings) is expected.

(3) *Pressure test.* The tank must be capable of maintaining, under hydrostatic test for at least 5 minutes, at least one and one-half times the design pressure prescribed in this paragraph, without detectable leakage or significant permanent deformation. The pressure must be measured at the top of the tank. Each closure must be in place and blocked if necessary as for shipment. Each closure must be standard, except that tapping for pressurizing and gaging is permitted. Design pressure must be determined as follows:

$$P=(hd/115)+3$$

Where:

P = Design pressure in p.s.i.g.;
h = Inside height of tank in inches;
d = Maximum allowable density in pounds per gallon;
115 = Number of cubic inches in 1 gallon (231) divided by a safety factor of two.

(b) *Production quality control, testing and inspection*—(1) *Leakage test.* Each tank must be leak tested by a minimum sustained air pressure of at least three pounds per square inch gage applied to the entire bank. The entire surface of all joints under pressure must be coated with or immersed in a solution of soap and water or other material suitable for the purpose of detecting leaks. The pressure must be held for a period of time sufficiently long to assure detection of leaks. All closures must be in place during the test, but safety relief devices may be removed and such openings plugged. Any tank that has detectable leakage or significant permanent deformation does not meet the requirements of this specification.

[Amdt. 178-60, 37 FR 2888, Feb. 9, 1972]

§ 178.255 Specification 60; steel portable tanks.

§ 178.255-1 General requirements.

(a) Tanks must be of fusion welded construction, cylindrical in shape with seamless heads concave to the pressure. Tank shells may be of seamless construction.

(b) Tanks must be designed and constructed in accordance with and fulfill all the requirements of the ASME Code.

(c) Tanks including all permanent attachments must be postweld heat treated as a unit.

(d) Requirements concerning types of valves, retesting, and qualification of portable tanks contained in §§ 173.32 and 173.315 of this chapter must be observed.

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18250, Nov. 14, 1969]

§ 178.255-2 Material.

(a) Material used in the tank must be steel of good weldable quality and conform with the requirements of the ASME Code.

(b) The minimum thickness of metal, exclusive of lining material, for shell and heads of tanks shall be as follows:

Tank capacity	Minimum thickness (inch)
Not more than 1,200 gallons	1/4
Over 1,200 to 1,800 gallons	5/16
Over 1,800 gallons	3/8

[29 FR 18972, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18250, Nov. 14, 1969]

§ 178.255-3 Expansion domes.

(a) Expansion domes, if applied, must have a minimum capacity of one percent of the combined capacity of the tank and dome.

§ 178.255-4 Closures for manholes and domes.

(a) The manhole cover shall be designed to provide a secure closure of the manhole. All covers, not hinged to the tanks, shall be attached to the outside of the dome by at least ⅛ inch chain or its equivalent. Closures shall be made tight against leakage of vapor and liquid by use of gaskets of suitable material.

§ 178.255-5 Bottom discharge outlets.

(a) Bottom discharge outlets prohibited, except on tanks used for shipments of sludge acid and alkaline corrosive liquids.

(b) If installed, bottom outlets or bottom washout chambers shall be of metal not subject to rapid deterioration by the lading, and each shall be provided with a valve or plug at its upper end and liquid-tight closure at it lower end. Every such valve or plug shall be designed to insure against unseating due to stresses or shocks incident to transportation. Bottom outlets shall be adequately protected against handling damage and outlet equipment must not extend to within less than one inch of the bottom bearing surface of the skids or tank mounting.

§ 178.255-6 Loading and unloading accessories.

(a) When installed, gauging, loading and air inlet devices, including their valves, shall be provided with adequate means for their secure closure; and means shall also be provided for the closing of pipe connections of valves.

(b) Interior heater coils, if installed, must be of extra heavy pipe and so constructed that breaking off of exterior connections will not cause leakage of tanks.

§ 178.255-7 Protection of valves and accessories.

(a) All valves, fittings, accessories, safety devices, gauging devices, and the like shall be adequately protected against mechanical damage by a housing closed with a cover plate.

(b) Protective housing shall comply with the requirements under which the tanks are fabricated with respect to design and construction, and shall be designed with a minimum factor of safety of four to withstand loadings in any direction equal to two times the weight of the tank and attachments when filled with water.

§ 178.255-8 Safety devices.

(a) Safety devices must be approved by the Associate Director for OE.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-59, 44 FR 66203, Nov. 19, 1979]

§ 178.255-9 Compartments.

(a) When the interior of the tank is divided into compartments, each compartment shall be designed, constructed and tested as a separate tank. Thickness of shell and compartment heads shall be determined on the basis of total tank capacity.

§ 178.255-10 Lining.

(a) If a lining is required, the material used for lining the tank shall be homogeneous, nonporous, imperforate when applied, not less elastic than the metal of the tank proper. It shall be of substantially uniform thickness, not less than 1/32 inch thick if metallic, and not less than 1/16 inch thick if nonmetallic, and shall be directly bonded or attached by other equally satisfactory means. Rubber lining shall be not less than 3/16 inch thick. Joints and seams in the lining shall be made by fusing the material together or by other equally satisfactory means. The interior of the tank shall be free from scale, oxidation, moisture and all foreign matter during the lining operation.

§ 178.255-11 Tank mountings.

(a) Tanks shall be designed and fabricated with mountings to provide a secure base in transit. "Skids" or similar devices shall be deemed to comply with this requirement.

(b) All tank mountings such as skids, fastenings, brackets, cradles, lifting lugs, etc., intended to carry loadings shall be permanently secured to tanks in accordance with the requirements under which the tanks are fabricated, and shall be designed with a factor of safety of four, and built to withstand loadings in any direction equal to two times the weight of the tanks and attachments when filled to the maximum permissible loaded weight.

(c) Lifting lugs or side hold-down lugs shall be provided on the tank mountings in a manner suitable for attaching lifting gear and hold-down devices. Lifting lugs and hold-down lugs welded directly to the tank shall be of the pad-eye type. Doubling plates welded to the tank and located at the points of support shall be deemed to comply with this requirement.

(d) All tank mountings shall be so designed as to prevent the concentration of excessive loads on the tank shell.

§ 178.255-12 Pressure test.

(a) Each completed portable tank prior to application of lining shall be tested before being put into transportation service by completely filling the tank with water or other liquid having a similar viscosity, the temperature of which shall not exceed 100° F. during the test, and applying a pressure of 60 pounds per square inch gauge. The tank shall be capable of holding the prescribed pressure for at least 10 minutes without leakage, evidence of impending failure, or failure. All closures shall be in place while the test is made and the pressure shall be gauged at the top of the tank. Safety devices and/or vents shall be plugged during this test.

§ 178.255-13 Repair of tanks.

(a) Tanks failing to meet the test may be repaired and retested, provided that repairs are made in complete compliance with the requirements of this specification.

§ 178.255-14 Marking.

(a) In addition to marking required by the American Society of Mechanical Engineers Code, every tank shall bear permanent marks at least ⅜ inch high stamped into the metal near the center of one of the tank heads or stamped into a plate permanently attached to the tank by means of brazing or welding or other suitable means as follows:

Manufacturer's name —— Serial No. ———
DOT specification ————————————
Nominal capacity —————— (gallons)
Tare weight —————— (pounds)
Date of manufacture ——————————

§ 178.255-15 Report.

(a) A copy of the manufacturer's data report required by the "Code" (see § 178.255-1(a)) under which the tank is fabricated shall be furnished for each new tank to the owner and the Associate Director for OE. In addition, the manufacturer or owner shall register each tank with the Associate Director for OE in the following form:

Place ————————————
Date ————————————
Portable tank
Manufactured for —————— Company
Location ————————————————
Manufactured by —————— Company
Location ————————————————
Consigned to ——————— Company
Location ————————————————
Size ——— feet outside diameter by ——— long.
Marks on tank as prescribed by § 178.255-14 of this specification are as follows:
Manufacturer's name ——————————
Serial number ————————————
Owner's serial number ————————
DOT specification ————————————
ASME Code Symbol (par U-201) ————
Date of manufacture ——————————
Nominal capacity —————— Gallons

It is hereby certified that this tank is in complete compliance with the requirements of *DOT specification No. 60.*

(Signed) ————————————
Manufacturer or owner

§ 178.270 Specification IM 101 and IM 102 steel portable tanks; general design and construction requirements.

[Amdt. 178-65, 46 FR 9895, Jan. 29, 1981]

§ 178.270-1 Specification requirements for IM 101 and IM 102 steel portable tanks.

(a) Each IM portable tank must meet the requirements of this section in addition to the requirements of § 178.271 (IM 101) or § 178.272 (IM 102). These requirements apply to IM portable tanks of diameters no greater than 2438 mm (96 inches) that are designed to carry liquids having a vapor pressure of less than 2.97 bar-absolute (43 psia) at a temperature of 50°C. (122°F.).

[Amdt. 178-65, 46 FR 9895, Jan. 29, 1981]

§ 178.270-2 General.

(a) Each tank, including attachments and service and structural equipment, must be designed to withstand, without loss of contents, the maximum internal pressure that can be anticipated to result from the contents and the static and dynamic stresses incurred in normal handling and transportation.

(b) For the purpose of this subchapter and the IM tank table "maximum allowable working pressure" or MAWP is the maximum pressure that an IM portable tank may experience during any normal operation (including loading and unloading). The only exception to this limitation is hydrostatic testing.

(c) Each portable tank must have a cross-sectional design that is capable of being stress analyzed either mathematically or by the experimental method contained in UG-101 of the ASME Code, or other method acceptable to the Associate Director for HMR.

(d) Each portable tank must be designed so that the center of gravity of the filled tank is approximately centered within the points of attachment for lifting devices.

(e) When credit is taken for insulation to reduce the required emergency venting capacity of safety relief devices, the insulation must be jacketed or otherwise protected from the accumulation of moisture or foreign matter that would decrease its efficiency or corrode the tank.

(f) Each portable tank that has a lining must have a lining material that meets the following requirements:

(1) The material used to line the tank must be—

(i) Substantially immune to attack by the hazardous material transported;

(ii) Homogeneous;

(iii) Nonporous;

(iv) Imperforated when applied;

(v) At least as elastic as the material of the tank shell; and

(vi) Have thermal-expansion characteristics compatible with the tank shell.

(2) The lining of the tank, tank fitting and piping must be—

(i) Attached by bonding or other satisfactory means;

(ii) Continuous; and

(iii) Extended around the face of any flange.

(3) Joints and seams in the lining must be made by fusing the material together or by other equally effective means.

[Amdt. 178-65, 46 FR 9895, Jan. 29, 1981, as amended by Amdt. 178-65, 46 FR 24184, Apr. 30, 1981]

§ 178.270-3 Materials of construction.

(a) Each portable tank must be constructed of carbon or alloy steels. Materials included in Part UHT of the ASME Code or equivalent materials are not authorized. Any materials used in the tank shell must conform to a recognized national standard and must be suitable for the external environments in which the tank will be carried. The minimum elongation for any material must be 20 percent or greater.

(b) The maximum stress allowed for a material shall be determined using one of the following methods:

(1) 1.5 times the specified values for the material at 93° C (200° F.) in Section VIII, Division 1 of the ASME Code;

(2) Derived by test for the actual yield and tensile strengths at 93° C (200° F) for the actual group of plates used to fabricate the tank using the methods described in §178.270-3(d); or

(3) Derived from the minimum yield and tensile strengths at 93° C (200° F) specified by the national standard to which the material is manufactured using the methods described in § 178.270-3(d).

(c) Maximum allowable stress values, derived for an actual group of plates, that are based on actual tensile and yield strengths of the material at 93° C. (200° F.) shall not be greater than 120 percent of the specified minimum yield and tensile strength specified in the national standard to which the material is manufactured.

(d) The maximum allowable stress values must be derived from the following criteria:

(1) For austenitic steels;

(i) When the yield strength is determined using the 0.2 percent offset, 93.75 percent of the yield strength.

(ii) When the yield strength is determined using the 1.0 percent offset, 75 percent of the yield strength.

(2) For carbon and low alloy steels, the yield strength is determined using

the 0.2 percent offset. The maximum allowable stress value is the lower of 93.75 percent of the yield strength or 37.5 percent of the tensile strength.

(e) For purposes of these specifications, tensile strength, yield strength and elongation must be determined using a specimen having a gauge length:

$$L_o = 5.65(S_o)^{1/2}$$

where:

L_o = the gauge length of the specimen—millimeters (inches); and

S_0 = the cross sectional area of the specimen—square millimeters (square inches).

Tensile tests and analysis of results must be in accordance with "ISO 82-1974(e) Steels-Tensile Testing." The yield strength in tension shall be the stress corresponding to a permanent strain of 0.2 percent of the gauge length, except that for high alloy austenitic steels the yield strength shall be the stress corresponding to a permanent strain of 0.2 or 1.0 percent of the gauge length as appropriate. The elongation must be at least 20 percent.

(f) If maximum allowable stress values or minimum tank wall thicknesses are based on the actual yield strength, the actual tensile strengh, or the actual elongation for the material used to fabricate the tank, the test records or certification of test results by the material producer or tank manufacturer must be approved by the approval agency, retained by the tank manufacturer for a period not less than 15 years, and made available to any duly identified representative of the Department or the owner of the tank.

[Amdt. 178-65, 46 FR 9895, Jan. 29, 1981]

§ 178.270-4 Structural integrity.

(a) *Maximum stress values.* The maximum calculated stress value in a tank at the Test Pressure must be less than or equal to that specified for the material of construction at 93°C. (200°F.) in § 178.270-3 of this part.

(b) *Tank shell loadings.* Tank shells, heads, and their fastenings shall be designed to prevent stresses in excess of two thirds those specified in § 178.270-3 of this part. The design calculations must include the forces imposed by each of the following loads:

(1) An internal pressure equal to the maximum allowable working pressure less 1 bar (14.5 psig) in combination with the simultaneously applied loadings of 3W vertically downward, 2W longitudinally, and 1W laterally acting through the center of the tank (W is the maximum permissible weight of the loaded tank and its attachments), and the requirements of paragraphs (b) (4), (5) and (6) of this section;

(2) An internal pressure equal to the maximum allowable working pressure less 1 bar (14.5 psig), in combination with the simultaneously applied loadings of 1W vertically upward, 2W longitudinally, and 1W laterally acting through the center of the tank (W is the maximum permissible weight of the loaded tank and its attachment), and the requirements of paragraphs (b) (4), (5) and (6) of this section;

(3) The load on the tank head resulting from an internal pressure equal to the maximum allowable working pressure, less 1 bar (14.5 psig), in combination with the dynamic pressure resulting from a longitudinal deceleration of 2 "g", and the requirements of paragraphs (b) (4), (5) and (6) of this section;

(4) Loads resulting from any discontinuities between tank shell and heads;

(5) Superimposed loads such as operating equipment, insulation, linings and piping; and

(6) Reactions of supporting lugs and saddles or other supports.

(c) The shell thickness used in calculating the resulting stress levels in a tank shall be exclusive of any corrosion allowance.

[Amdt. 178-65, 46 FR 9895, Jan. 29, 1981]

§ 178.270-5 Minimum thickness of shells and heads.

(a) For the purposes of this section, mild steel is steel with a guaranteed minimum tensile strength of 37 dekanewtons per square millimeter (53,650 p.s.i.) and a guaranteed elongation of 27 percent or greater.

(b) Except as otherwise provided in this subchapter, the shell and heads of each portable tank constructed of reference mild steel—

(1) With a maximum cross-sectional dimension of 1.8 meters (5.9 feet) or less, shall be at least 5mm (0.197 inches) thick; or,

(2) With a maximum cross-sectional dimension exceeding 1.8 meters (5.9 feet), shall be at least 6.35mm (0.250 inches) thick.

(c) The minimum thickness of the shell and heads of each portable tank constructed of a steel other than the reference mild steel, shall be obtained from the following formula:

Formula for metric units

$e_1=(10e_o)/(Rm_1\ A_1)^{1/3}$

Formula for nonmetric units

$e_1=(112.3e_o)/(Rm_1\ A_1)^{1/3}$

where:

e_o=Required thickness of the reference steel from § 178.270-5(b)—millimeters (inches);

e_1=Equivalent thickness of the steel used—millimeters (inches);

Rm_1=Specified minimum tensile strength of the steel used—deka newtons per square millimeter (p.s.i.); and

A_1=Specified minimum percentage elongation of the steel used—percent times 100 (i.e., if 20% use 20.0).

(d) When other than the standard minimum thickness for the reference mild steel is specified for a tank in the IM Tank Table, the specified minimum shell and head thickness must be at least equal to the larger of the thicknesses calculated from the formula given in § 178.270-5(c) and the following formula:

Formula for metric units

$3_1=(10e_o\ d_1)/1.8(Rm_1\ A_1)^{1/3}$

Formula for nonmetric units

$e_1=(112.3e_o\ d_1)/5.9(Rm_1\ A_1)^{1/3}$

where:

e_1=Equivalent thickness of the steel used—millimeters (inches);

e_o=The specified minimum shell and head thickness of the reference mild steel specified in the IM Tank Table—millimeters (inches);

d_1=Actual outside diameter of the tank—meters (feet);

Rm_1=Specified minimum tensile strength of the steel used—deka newtons per square millimeter (p.s.i.); and

A_1=Specified minimum percentage elongation of the steel used—percent times 100 (i.e., if 20% use 20.0).

NOTE: For paragraph (c) and (d) of this section the actual values for the tensile strength and percent elongation for the steel, as determined through tests on specimens from the group of plates to be used in the fabrication of the tank, may be substituted for the specified minimum values in the calculation prescribed in this paragraph (See § 178.270-3 of this part). Test records or certification of test results by the material producer or tank manufacturer must be retained by the tank manufacturer for a period not less than 15 years and must be made available to the Department or the owner of the tank.

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981]

§ 178.270-6 Tank supports, frameworks and lifting attachments.

(a) Each portable tank must be constructed with a permanent support structure that provides a secure base in transport. Skids, frameworks, cradles, or similar devices are acceptable. The calculated stress in tank supports, frameworks, and lifting attachments must not exceed 80 percent of the specified minimum yield strength of the material of construction under the applicable loading conditions specified in § 178.270-4(b).

(b) An IM portable tank that meets the definition of "container" in § 450.3(a)(3) must meet the requirements of Parts 450 through 453 of this title, in addition to the requirements of this subchapter.

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981]

§ 178.270-7 Joints in tank shells.

Joints in tank shells must be made by fusion welding. Such joints and their efficiencies must be as required by the ASME Code. Weld procedures and welder performance must be ASME Code qualified or must be qualified by the approval agency in accordance with the procedures in the ASME Code, Section IX, Welding and Brazing Qualifications. A record of each qualification must be retained by the manufacturer for the period prescribed in ASME Code, Section VIII, Pressure Vessels, and must be made available to any duly identified representative of the Department and the owner of the tank.

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981; 46 FR 24184, Apr. 30, 1981]

§ 178.270-8 Protection of valves and accessories.

Each valve, fitting, accessory, safety device, gauging device, and other appurtenance shall be adequately protected against mechanical damage.

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981]

§ 178.270-9 Inspection openings.

Each portable tank must be fitted with a manhole or other inspection opening sited above the maximum liquid level to allow for complete internal inspection and adequate access for maintenance and repair of the interior. Each portable tank with a capacity of more than 1894 liters (500 gallons) must be fitted with an elliptical or obround manhole at least 279 × 381 millimeters (11 × 15 inches), or 254 × 405 millimeters (10 × 16 inches), or with a circular manhole at least 381 millimeters (15 inches) in diameter. Any inspection opening and closure must be designed and reinforced as required by the ASME Code.

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981]

§ 178.270-10 External design pressure.

(a) Each portable tank not fitted with vacuum relief devices must be designed to withstand a positive external pressure differential of at least 0.4 bar >(6 p.s.i.).

(b) Each portable tank fitted with vacuum relief devices must be designed to withstand a positive external pressure differential not less than the set pressure of the vacuum relief device and in any case at least 0.21 bar (3 p.s.i.).

[Amdt. 178-65, 46 FR 9896, Jan. 29, 1981]

§ 178.270-11 Pressure and vacuum relief devices.

(a) *Relief devices required.* Each portable tank, or each independent compartment of a portable tank, must be fitted with pressure relief devices in accordance with the following:

(1) Each portable tank, or each independent compartment of a portable tank, with a capacity of more than 1893 liters (500 gallons), must be provided with a primary pressure relief device consisting of a spring-loaded pressure relief valve and, in addition, may have one or more emergency pressure relief devices that may be a spring-loaded pressure relief valve, a frangible disc or fusible element in parallel with the primary pressure relief device.

(2) Each portable tank, or each independent compartment of a portable tank, with a capacity of 1893 liters (500 gallons) or less, must be fitted with a primary pressure relief device that may either be a frangible disc or a spring-loaded pressure relief valve.

(3) If a frangible disc is inserted in series with required pressure relief valve, the space between the frangible disc and the pressure relief valve must be provided with a suitable tell-tale indicator to permit detection, prior to and during shipment, of disc rupture, pinholing, or leakage which could cause a malfunction of the pressure relief system. The frangible disc must rupture at a tank pressure within the range specified in paragraph (c)(1) of this section.

(b) *Location and construction of relief devices.* (1) Pressure relief devices must be spring-loaded valves, frangible discs, or fusible elements. Vacuum relief devices must be capable of reclosing in any attitude. Each pressure relief device inlet must be situated in the vapor space of the tank. The discharge from any device must be unrestricted and directed to prevent impingement upon the tank shell or structural framework. Protective devices which deflect the flow of vapor are permissible provided the required vent capacity is maintained. Pressure and vacuum relief devices including their inlets must be sited on the top of the tank in a position as near as possible to the longitudinal and transverse center of the tank within the following limitation:

(i) Longitudinally on the tank within 107 cm(3½ feet) or ⅛ the tank length, whichever is less, from the top center of the tank; and

(ii) Transversally within 12 degrees of the tank top.

(2) Except for a relief device installed in a piping system, each relief device must provide unrestricted venting under all conditions. Each pressure relief system, including any piping, must provide a venting capacity at

least equal to the venting capacity specified in § 178.270-11(d) for the tank on which the system is installed.

(3) Fusible elements, when installed, must not be protected from direct communication with external heat sources.

(4) Spring-loaded pressure relief valves must be constructed in a manner to prevent unauthorized adjustment of the relief setting.

(c) *Pressure settings of relief devices*—(1) *Primary pressure relief devices.* The primary relief device required by paragraph (a) of this section must be set to function in a range of no less than 100 percent and no greater than 125 percent of the maximum allowable working pressure (MAWP) for tanks having a MAWP below 44 psig. For tanks having a MAWP of 44 psig or greater, the primary pressure relief device must be set to function in a range of no less than 100 percent and no greater than 110 percent of the MAWP. Spring-loaded pressure relief valves must close after discharge at a pressure not less than 90 percent of the start-to-discharge pressure and remain closed at all lesser pressures.

(2) *Emergency pressure relief devices.* Each frangible disc, other than those used as a primary relief device in accordance with paragraph (b)(2) of this section, must be designed to burst at a pressure greater than 125 percent and less than or equal to 150 percent of the MAWP. Each spring loaded pressure relief valve used as an emergency pressure relief device must be set to operate at no less than 125 percent of the MAWP and be fully open at 150 percent of the MAWP.

(3) *Fusible elements.* Fusible elements must have a nominal yield temperature greater than the highest tank operating temperature and less than or equal to 121°C. (250°F.). The pressure developed in the tank at the fusible element yield temperature must be below the test pressure of the tank.

(4) *Vacuum relief devices.* Vacuum relief devices, when used, must be designed to provide total containment of product under normal and accident conditions and must be set to open at a nominal external overpressure of not less than 0.21 bar (3 pounds per square inch) but not greater than the external pressure for which the tank is designed. Each vacuum relief device must have a minimum cross sectional flow area of 2.84 cm ^{2} (0.44 square inches).

(d) *Venting capacity of pressure relief devices*—(1) *Pressure relief valves (spring-loaded).* Each pressure relief valve must have a minimum vent capacity of at least 170 standard cubic meters per hour (SCMH) (6.000 standard cubic feet per hour (SCFH)). The minimum total pressure relief valve vent capacity for each tank shall be 340 SCMH (12,000 SCFH) per 32.5 m^2 (350 square feet) of exposed tank area, but in any case at least 340 SCMH (12,000 SCFH).

(2) *Total tank vent capacity.* The total vent capacity of all pressure relief devices installed on each portable tank must be sufficient with all devices operating to limit the pressure in the tank or less than or equal to the test pressure. Except as provided in paragraph (d)(3) or (d)(4) of this section, the total vent capacity must be at least equal to that shown in the following table:

TABLE I.—*Minimum total vent capacity*

[Metric units table in cubic meters of air per hour at atmospheric pressure and 15°C.]

Exposed area square meters	Cubic meters free air per hour	Exposed area square meters	Cubic meters free air per hour
2	841	37.5	9.306
3	1,172	40	9,810
4	1,485	42.5	10,308
5	1,783	45	10,806
6	2,069	47.5	11,392
7	2,348	50	11,778
8	2,621	52.5	12,258
9	2,821	55	12,732
10	3,146	57.5	13,206
12	3,655	60	13,674
14	4,146	62.5	14,142
16	4,625	65	14,604
18	5,092	67.5	15,066
20	5,556	70	15,516
22.5	6,120	75	16,422
25	6,672	80	17,316
27.5	7,212	85	18,198
30	7,746	90	19,074
32.5	8,268	95	19,938
35	8,790	100	20,790

[Nonmetric units in cubic feet of air per hour at atmospheric pressure and 59°F.]

Exposed area square feet	Cubic feet free air per hour	Exposed area square feet	Cubic feet free air per hour
20	27,600	275	237,000
30	38,500	300	256,000
40	48,600	350	289,500
50	58,600	400	322,100
60	67,700	450	355,900
70	77,000	500	391,000
80	85,500	550	417,500
90	94,800	600	450,000
100	104,000	650	479,000
120	121,000	700	512,000
140	136,200	750	540,000
160	152,100	800	569,000
180	168,200	850	597,000
200	184,000	900	621,000
225	199,000	950	656,000
250	219,500	1,000	686,000

Note.—Interpolate for intermediate sizes.

(3) Notwithstanding the minimum total vent capacity shown in Table I, of paragraph (d)(2), a tank in dedicated service may have a lesser total vent capacity provided the approval certificate required by § 173.32a of this subchapter specifies the hazardous materials for which the tank is suitable. The lesser total vent capacity must be determined in accordance with the following formula:

Formula for metric units

$$Q=5{,}660{,}000\ A^{0.82}(ZT)^{0.5}/(LC)(M^{0.5})$$

Formula for nonmetric units

$$Q=37{,}980{,}000\ A^{0.82}(ZT)^{0.5}/(LC)(M^{0.5})$$

where:

Q=The total required venting capacity, in cubic meters of air per hour at standard conditions of 15.6°C. and 1 atm (cubic feet of air per hour at standard conditions of 60°F. and 14.7 psia);
T=The absolute temperature of the vapor at the venting conditions—degrees Kelvin (°C+273) [degrees Rankine (°F+460)];
A=The exposed surface area of tank shell—square meters (square feet);
L=The latent heat of vaporization of the lading—calories per gram (BTU/lb);
Z=The compressibiliy factor for the vapor (if this factor is unknown, let Z equal 1.0);
M=The molecular weight of vapor;
C=A constant derived from (K), the ratio of specific heats of the vapor. If (K) is unknown, let C=315.

$$C=520[K(2/(K+1))^{[(K+1)/(K-1)]}]^{1/2}$$

where:

$K=C_p/C_v$
C_p=The specific heat at constant pressure, in -calories per gram degree centigrade (BTU/lb°F.); and
C_v=The specific heat at constant volume, in -calories per gram degree centigrade (BTU/lb°F.).

(4) The required total venting capacity determined by using Table I or paragraph (d)(3) of this section may be reduced for insulated tanks to Q_t by the following formula:

$$Q_t=FQ_i$$

where:

Q_t=The total required venting capacity of the insulated tank;
Q_i=The total venting capacity required for an uninsulated tank according to Table I or paragraph (d)(3) of this section;
F=A coefficient with a value greater than or equal to 0.25 according to the following formula:

Formula for metric units

$$F=8U(649-t)/93.5\times10^6$$

Formula for nonmetric units

$$F=8U(1200-t)/34{,}500$$

where:

U=The thermal conductance of the insulation system taken at 38°C. (100°F.), in gram calories per hour sq. meter °C. (BTU per hour sq. feet °F); and
t=The actual temperature of the substance at loading, in °C. (°F.).

(5) Insulation systems, used for the purpose of reducing the venting capacity, must be approved by the approval agency. In all cases, insulation systems approved for this purpose must:

(i) Remain effective at all temperatures up to 649°C. (1200°F.); and

(ii) Be jacketed with a material having a melting point of 649°C. (1200°F.) or greater.

(6) The flow capacity rating of any pressure relief device must be certified by the manufacturer to be in accordance with the applicable provisions of the ASME Code with the following exceptions:

(i) The ASME Code stamp is not required; and

(ii) The flow capacity certification test for spring loaded pressure relief valves may be conducted at a pressure not to exceed 120% of the set pressure provided the stamped flow capacity rating is not greater than 83% of the average capacity of the valves tested.

(e) *Markings on pressure and vacuum relief devices.* The following information shall be plainly displayed on each pressure relief device:

(1) The pressure or, when appropriate, the temperature at which the device is set to function;

(2) Except for vacuum relief devices, the rated flow capacity of air discharged per minute at 15°C. (59°F.) and atmospheric pressure, at:

(i) The set pressure for frangible discs;

(ii) No greater than 20% above the start to discharge pressure for spring-loaded relief devices; or,

(iii) The fusing temperature for fusible elements.

(3) The manufacturer's name and catalog number; and

(4) The allowable tolerances at the start to discharge pressure and the allowable tolerances at the discharge temperature.

[Amdt. 178-65, 46 FR 9897, Jan. 29, 1981; 46 FR 24184, Apr. 30, 1981]

§ 178.270-12 Valves, nozzles, piping, and gauging devices.

(a) All tank nozzles, except for those provided for relief devices, thermometer wells, and inspection openings, must be fitted with manually operated stop valves located as near the shell as practicable either internal or external to the shell. A tank nozzle installed for a pressure relief device must not be provided with a stop valve that restricts the flow from the tank to the pressure relief device (see § 178.270-11(b)(2)). A tank nozzle installed in the vapor space to provide a filling or cleaning opening, which is closed by a blank flange or other suitable means, need not be provided with a manually operated stop valve. A tank nozzle installed for a thermometer well or inspection opening need not be provided with a manually operated stop valve.

(b) Each valve must be designed and constructed to a rated pressure not less than the maximum allowable working pressure of the tank. Each stop valve with a screwed spindle must be closed by a clockwise motion of the handwheel. All valves must be constructed to prevent unintentional opening.

(c) Each internal discharge valve shall be self-closing, located inside the tank, within the welded flange or within its companion flange.

(d) A shear section must be located outboard of each internal discharge valve seat and within 10.2 cm (4 inches) of the vessel. The shear section must break under strain without affecting the product retention capabilities of the tank and any attachments.

(e) All piping must be of suitable material. Welded joints must be used wherever practicable. The bursting strength of all piping and pipe fittings must be at least 4 times the maximum allowable working pressure of the tank. Piping must be supported in such a manner as to prevent damage due to thermal stresses, jarring or vibration.

(f) All nozzles and tank shell penetrations for nozzles shall be designed and constructed in accordance with the ASME Code.

(g) Glass liquid level gauges, or gauges of other easily destructible material, which are in direct communication with the contents of the tank are prohibited.

[Amdt. 178-65, 46 FR 9898, Jan. 29, 1981; 46 FR 24184, Apr. 30, 1981]

§ 178.270-13 Testing.

(a) *Hydrostatic test.* Each portable tank and all piping, valves, and other attachments which are subject to the pressure of the contents of the tank, except pressure relief devices, must be hydrostatically tested by completely filling the tank (including domes, if any) with water or other liquid having a similar density and viscosity and applying a pressure of at least 150 percent of the maximum allowable working pressure. The pressure shall be maintained for at least 10 minutes. While under pressure, the tank shall be inspected for leakage, undue distortion, or other conditions which indicate weakness or which might render the tank unsafe for transportation service. Failure to successfully meet the test criteria shall be deemed evidence of failure to meet the requirements of this specification. Tanks failing to pass the test shall be suitably repaired and must successfully pass the prescribed tests prior to use for transporting any hazardous material.

(b) *Testing of internal coils.* Internal coils, if installed, must be hydrostatically tested to an internal pressure of 13.8 bar (200 psig) or 150 percent of the rated pressure of the coils, whichever is greater.

(c) *Tank container qualification test.* For each tank design, a prototype tank, using a framework for containerized transport, must fulfill the requirements of Parts 450-453 of this title for compliance with the requirements of Annex II of the International Convention for Safe Containers. In addition, the following tests must be completed without leakage or deformation that would render the tank unsuitable for use:

(1) *Longitudinal inertia.* The tank loaded to its maximum gross weight must be positioned with its longitudinal axis vertical. It shall be held in this position for five minutes by support at the lower end of the base structure providing vertical and lateral restraint and by support at the upper end of the base structure providing lateral restraint only.

(2) *Lateral inertia.* The tank loaded to its maximum gross weight must be positioned for five minutes with its transverse axis vertical. It shall be held in this position for five minutes by support at the lower side of the base structure providing vertical and lateral restraint and by support at the upper side of the base structure providing lateral restraint only.

(d) *Approval of smaller tanks of the same design.* Design approval must include the prototype testing of at least one tank of each design and each size; however, a set of tests made on a tank of one size may serve for the approval of smaller tanks with equal or lesser diameter and length) made of the same material and thickness by the same fabrication technique and with identical supports and equivalent closures and other appurtenances.

(e) *Pressure and vacuum relief devices.* Each spring loaded relief device must be tested for the accuracy of the setting prior to installation on a tank and must be effectively sealed to maintain the required setting.

[Amdt. 178-65, 46 FR 9898, Jan. 29, 1981; 46 FR 24184, Apr. 30, 1981]

§ 178.270-14 Marking of tanks.

(a) *General.* Each tank must bear a corrosion resistant metal identification plate that is permanently attached to the portable tank and readily accessible for inspection. The information required in paragraph (b), and, when appropriate, paragraph (c) of this section must be stamped, embossed or otherwise marked by an equally durable method on the plate in characters at least 3 mm (0.118 inches) high. The plate must not be painted.

(b) *Required information.* At least the following information must appear on the metal identification plate for each tank:

(1) US DOT Specification number.

(2) Country of manufacture.

(3) Manufacturer's name.

(4) Date of manufacture.

(5) Manufacturer's serial number.

(6) Identification of USA/DOT approval agency and approval number.

(7) Maximum allowable working pressure, in bar or psig.

(8) Test pressure, in bar or psig.

(9) Total measured water capacity at 20°C. (68°F.), in liters or gallons.

(10) Maximum allowable gross weight, in kg or lbs.

(11) Equivalent minimum shell thickness in mild steel, in mm or inches.

(12) Tank material and specification number.

(13) Metallurgical design temperature range, in °C. and °F.

(c) *Additional information.* The following additional information must appear on the metal identification plate when applicable:

(1) Lining material.

(2) Heating coil maximum allowable working pressure in bar and psig.

(3) Corrosion allowance, in mm or in.

(d) In addition to the markings required above, each tank used in international transport must have a Safety Approval Plate containing the information required in §§ 451.21 through 451.25 of this title.

(e) Nothing in this section shall be deemed to preclude the display of other pertinent information on the required metal identification plate.

[Amdt. 178-65, 46 FR 9899, Jan. 29, 1981]

§ 178.271 Specification IM 101 steel portable tanks.

[Amdt. 178-65, 46 FR 9899, Jan. 29, 1981]

§ 178.271-1 General requirements.

(a) Specification IM 101 portable tanks must comply with the general design and construction requirements in § 178.270 of this subpart in addition to the specific design requirements contained in this section.

(b) The maximum allowable working pressure of each tank shall be equal to or greater than 1.75 bar (25.4 psig) and less than 6.8 bar (100 psig).

(c) Each tank shall be designed and constructed in accordance with the requirements of Section VIII, Division 1, of the ASME Code except as limited or modified in this section or in § 178.270 of this subpart. ASME certification or stamp is not required.

[Amdt. 178-65, 46 FR 9899, Jan. 29, 1981]

§ 178.272 Specification IM 102 steel portable tanks.

[Amdt. 178-65, 46 FR 9899, Jan. 29, 1981]

§ 178.272-1 General requirements.

(a) Specification IM 102 portable tanks must comply with the general design and construction requirements in § 178.270 of this subpart in addition to the specific design requirements contained in this section.

(b) The maximum allowable working pressure of each tank shall be less than 1.75 bar (25.4 psig) but at least 1.0 bar (14.5 psig).

(c) Each tank shall be designed and constructed in accordance with the requirements of Section VIII, Division 1, of the ASME Code except as limited or modified in this section or in § 178.270 of this subpart. ASME certification or stamp is not required.

[Amdt. 178-65, 46 FR 9899, Jan. 29, 1981]

§ 178.272-2 Minimum thickness of shells and heads.

(a) The approval agency may authorize a minimum thickness less than that required by § 178.270-5 of this subpart where additional protection against tank puncture provides equal integrity.

(b) The shell and head thickness of a tank must be at least:

(1) 3.18 mm (0.125 inches) for a tank with a maximum cross-sectional dimension of 1.8 meters (5.9 feet) or less; or

(2) 4 mm (0.157 inches) for a tank constructed of the reference mild steel having a maximum cross-sectional dimension exceeding 1.8 meters (5.9 feet). For tanks having a maximum cross-sectional dimension exceeding 1.8 meters (5.9 feet) constructed of other steels, an equivalent head and shell thickness calculated in accordance with § 178.270-5(c) of this subpart may be used, subject to an absolute minimum of 3.18 mm (0.125 inches).

(c) The following additional puncture protection systems are authorized:

(1) An overall external structural protection, such as a jacket, which is rigidly secured to the tank with a layer of cushioning material installed between the external structural protection and the tank; or

(2) A complete framework surrounding the tank including both longitudinal and transverse structural members.

[Amdt. 178-65, 46 FR 9899, Jan. 29, 1981]

Subpart I—[Reserved]

Subpart J—Specifications for Containers for Motor Vehicle Transportation

SOURCE: 29 FR 18975, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

§ 178.315 Specification MC 200; containers for liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate.

§ 178.315-1 Motor vehicle body.

(a) Every motor vehicle used for the transportation of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate, other than desensitized liquid explosives, as defined in § 173.53(e) of this chapter, shall have a body constructed as set forth below, which body shall have component parts as specified hereinafter.

§ 178.315-2 Body proper.

(a) The motor-vehicle body proper shall have a hinged cover. Both the body and the cover shall be well and strongly built of wood or other nonsparking material of equal strength, thoroughly waterproofed, having no end or side openings, and lined with copper or other nonsparking sheet metal having all seams made tight against leakage of nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate by welding, brazing, or soldering. No metal of such character as to be capable of producing a spark when struck may be exposed on the inside or the top of the body, nor on the nether side or any edge of the cover, the top of which shall be covered with metal. The body shall be of such dimensions that it will contain only a single tier of individual containers and of such approximate height that the felt pads will securely constrain all inside containers from vertical motion with respect to the body, and shall be securely and firmly attached to the chassis of the motor vehicle. The total load shall not exceed nine hundred (900) quarts liquid measure of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate.

§ 178.315-3 Cellular construction.

(a) In the motor-vehicle body specified in § 178.315-2 shall be inserted suitable wooden or other nonmetallic, nonsparking cellular construction, the dimensions of each cell of which shall be such that the rubber "boot" or secondary container for the primary container of the nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate, both of which are specified hereinafter, shall snugly fit. The cellular construction shall extend from near the top to near the bottom of the full height of each "boot" to be fitted therein, and shall rest upon and be covered by at least one-half (½) inch of felt padding or other material affording equivalent shock-absorbing protection. The cellular construction shall be of such strength as to provide suitable restraint under all conditions of loading to prevent relative motion of inside containers to be inserted or carried therein.

§ 178.315-4 Inside containers and boots.

(a) *Inside containers.* Individual containers shall be made of copper or other nonsparking metal of equivalent strength, with all seams closed by welding, brazing or soldering, and shall be tight against leakage of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate. No individual container shall exceed ten (10) quarts (liquid measure) capacity of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate.

(b) *Boots, rubber containers for individual containers.* Each individual container of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate shall be contained in a rubber boot or outer container into which it shall snugly fit, and which, in turn, shall snugly fit into any cell of the cellular construction specified in § 178.315-3. This boot shall be watertight throughout and at least of such volume as to contain all of the liquid content of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate of any inside container inserted in it. It shall be provided with V-shaped grooves at suitable spacings throughout its inside surface, extending from top to bottom in such manner as to prevent the entrapment of air therein upon insertion of the inside container of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate. The inside height of the rubber boot shall approximate the height of the inside container (including stopper) as shipped.

§ 178.315-5 Marking.

Each container must be marked as prescribed in § 173.24 of this subchapter.

[Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]

§ 178.318 Specification MC 201; container for detonators and percussion caps.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18975, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-60, 44 FR 70733, Dec. 10, 1979]

§ 178.318-1 Scope.

(a) This specification pertains to a container to be used for the transportation of detonators and percussion caps in connection with the transportation of liquid nitroglycerin, desensitized liquid nitroglycerin or diethylene glycol dinitrate, where any or all of such types of caps may be used for the detonation of liquid nitroglycerin, desentitized liquid nitroglycerin or diethylene glycol dinitrate in blasting operations. This specification is not intended to take the place of any shipping or packing requirements of this Department where the caps in question are themselves articles of commerce.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18975, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-60, 44 FR 70733, Dec. 10, 1979]

§ 178.318-2 Container.

(a) Every container for detonators and percussion caps coming within the scope of this specification shall be constructed entirely of hard rubber, phenolresinous or other resinous material, or other nonmetallic, nonsparking material, except that metal parts may be used in such locations as not in any event to come in contact with any of the caps. Space shall be provided so that each detonator of whatever nature may be inserted in an individual cell in the body of the container, into which each such cap shall snugly fit. There shall be provided no more than twenty (20) such cellular spaces. Space may be provided into which a plurality of percussion caps may be carried, provided that such space may be closed with a screw cap, and further provided that each or any such space is entirely separate from any space provided for any detonator. Each cellular space into which a detonator is to be inserted and carried shall be capable of being covered by a rotary cover so arranged as to expose not more than one cell at any time, and capable of rotation to such a place that all cells will be covered at the same time, at which place means shall be provided to lock the cover in place. Means shall be provided to lock in place the cover for the cells provided for the carrying of detonators. The requirement that not more than one cell be exposed at one time need not apply in the case of detonators, although spaces for such caps and detonators shall be separate. Sufficient annular space shall be provided inside the cover for such detonators that, when the cover is closed, there will be sufficient space to accommodate the wires customarily attached to such caps. If the material is of such a nature as to require treatment to prevent the absorption of moisture, such treatment shall be applied as shall be necessary in order to provide against the penetration of water by permeation. A suitable carrying handle shall be provided, except for which handle no part of the container may project beyond the exterior of the body.

(b) Exhibited in plates I and II are line drawings of a container for detonators and percussion caps, illustrative of the requirements set forth in § 178.318-2(a). These plates shall not be construed as a part of this specification.

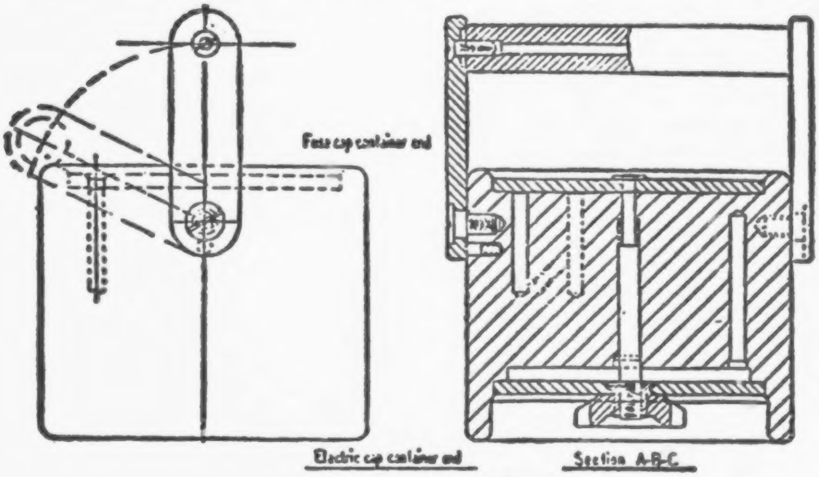
(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18975, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-60, 44 FR 70733, Dec. 10, 1979]

§ 178.318-3 Marking.

Each container must be marked as prescribed in § 173.24 of this subchapter.

[Amdt. 178-40, 41 FR 38181, Sept. 9, 1976]


Fuse cap container end
Electric cap container end
Section A-B-C

BLASTING CAP CONTAINER
PLATE I.

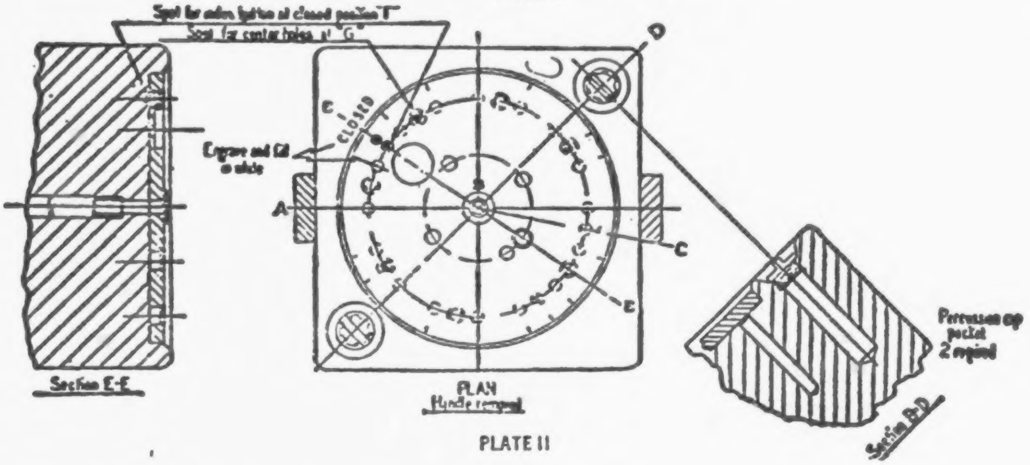

Spot for index button at closed position "F"
Spot for center holes at "G"
Engrave and fill in white
CLOSED
A
C
D
E
Percussion cap pocket 2 required
Section E-E
PLAN (Handle removed)
Section D-D

PLATE II

§ 178.337 Specification MC 331; cargo tanks constructed of steel, primarily for transportation of compressed gases as defined in the Compressed Gas Section.

[Amdt. 178-37, 40 FR 24904, June 11, 1975]

§ 178.337-1 General requirements.

(a) *ASME Code construction.* Tanks must be seamless or welded steel construction or combination of both and must be designed and constructed in accordance with and fulfill the requirements of the ASME Code. Each tank must also meet the following additional requirements.

(b) *Design pressure.* The design pressure of a tank authorized under this specification shall be not less than the vapor pressure of the commodity contained therein at 115° F. or as prescribed for a particular commodity in § 173.315 (a) (1) of this chapter, except that in no case shall the design pressure of any tank be less than 100 p.s.i.g. nor more than 500 p.s.i.g.

NOTE 1: The term "design pressure" as used in this specification, is identical to the term "maximum allowable working pressure" as used in the ASME Code.

(c) *Openings.* (1) Excess pressure relief valves shall be located in the top of the tank or heads.

(2) A chlorine tank shall have only one opening. That opening shall be in the top of the tank and shall be fitted with a nozzle that meets the following requirements:

(i) On a tank manufactured on or before December 31, 1974, the nozzle shall be protected by a dome cover plate which conforms to either the standard of The Chlorine Institute, Inc., Dwg. 103-3, dated January 23, 1958, or to the standard specified in paragraph (c) (2) (ii) of this section.

(ii) On a tank manufactured on or after January 1, 1975, the nozzle shall be protected by a manway cover which conforms to the standard of The Chlorine Institute, Inc., Dwg. 103-4, dated September 1, 1971.

(d) *Reflective design.* Every uninsulated tank permanently attached to a tank motor vehicle shall, unless it be covered with a jacket made of aluminum, stainless steel, or other bright nontarnishing metal, be painted a white, aluminum or similar reflecting color on the upper two-thirds of area of the tank.

(e) *Insulation for carbon dioxide, chlorine, and nitrous oxide tanks.* See § 173.33(i) of this subchapter.

(f) *Postweld heat treatment.* Postweld heat treatment must be as prescribed in the ASME Code except that each tank constructed in accordance with Part UH of the ASME Code must be postweld heat treated. Each chlorine tank must be fully radiographed and postweld heat treated in accordance with the provisions of the ASME Code under which it is constructed. Where postweld heat treatment is required, the tank must be treated as a unit after completion of all the welds in and/or to the shells and heads. The method must be as prescribed in the ASME Code. Welded attachments to pads may be made after postweld heat treatment. A tank used for anhydrous ammonia must be post-weld heat treated. The post-weld heat treatment must be as prescribed in the ASME Code, but in no event at less than 1050° F. tank metal temperature.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 (e))

[Order 59-B, 30 FR 579, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.337-1 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.337-2 Material.

(a) *General.* (1) All material used for construction of the tank and appurtenances must be suitable for use with the commodities to be transported therein and must comply with the requirements of the ASME Code and/or requirements of the American Society for Testing and Materials in all respects.

(2) Impact tests are required on steel used in fabrication of each tank constructed in accordance with Part UHT of the ASME Code. The tests must be made on a lot basis. A lot is defined as 100 tons or less of the same heat treatment processing lot having a thickness variation no greater than plus or minus 25 percent. The minimum impact required for full size specimens must be 20 foot-pounds in the longitudinal direction at −30° F., Charpy V-Notch and 15 foot-pounds in the transverse direction at −30° F., Charpy V-Notch. The required values for subsize specimens must be reduced in direct proportion to the cross-sectional area of the specimen beneath the notch. If a lot does not meet this requirement, individual plates may be accepted if they individually meet this requirement.

(3) The fabricator shall record the heat, and slab numbers, and the certified Charpy impact values, where required, of each plate used in each tank on a sketch showing the location of each plate in the shell and heads of the tank. Copies of each sketch shall be provided to the owner and retained for at least five years by the fabricator and made available to duly identified representatives of the Department of Transportation.

(4) The direction of final rolling of the shell material shall be the circumferential orientation of the tank shell.

(b) *For a chlorine tank.* Plates, the manway nozzle, and anchorage shall be made of carbon steel which meets the following requirements:

(1) For a tank manufactured on or before December 31, 1974—

(i) Material shall conform to ASTM Specification A-300 -58, titled "Steel Plates for Pressure Vessels for Service at Low Temperatures";

(ii) Material shall be Class 1, Grade A, flange or firebox quality;

(iii) Plate impact test specimens, as required under paragraph (a) of this section, shall be of the Charpy keyhole notch type; and

(iv) Plate impact test specimens

shall meet the impact test requirements in paragraph (a) of this section in both the longitudinal and transverse directions of rolling at a temperature of minus 45.5 C. (−50° F.).

(2) For a tank manufactured on or after January 1, 1975—

(i) Material shall conform to ASTM Specification A-612-72a, Grade B or A-516-72, Grade 65 or 70;

(ii) Material shall meet the Charpy V-notch test requirements of ASTM Specification A-20-72a; and

(iii) Plate impact test specimens shall meet the impact test requirements in paragraph (a) of this section in both the longitudinal and transverse directions of rolling at a temperature of minus 40° C. (−40° F.).

(c) *For ammonia.* See § 173.33(g)(1) of this subchapter.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 (e))

[Order 59-B, 30 FR 579, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.337-2 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.337-3 Thickness of tank metal.

(a) Tank metal thickness must be as required by the ASME Code and paragraph (b) of this section, except that metal of thickness less than three-sixteenths inch may not be used for the shell or heads. A corrosion allowance of 20 percent or 0.10 inch, whichever is less, must be added to the thickness otherwise required for sulfur dioxide and chlorine tank material. In chlorine tanks the wall thickness must be at least five-eighths inch, including corrosion allowance.

(b) The minimum thickness of metal in the tank shell must be such that at no point therein will the stress on a plane normal to the cylindrical axis exceed 25 percent of the minimum specified tensile strength of the metal. For purposes of this requirement, calculation must be made by the formula:

$$S=(T/2)+[(T^2/4)+S_s^2]^{0.5}$$

where, at any given point under consideration and for the worst combination of loadings:

S=Effective stress as limited by this requirement:

T=The sum of the longitudinal tensile stresses due to internal pressure and other causes including direct tensile stress due to a rearward accelerative force equal to twice the static weight, tensile stress due to the bending moment of a rearward accelerative force equal to twice the static weight, applied at the road surface, and tensile flexure stress due to three times the static weight in vertical loading; and

S=The vectorial sum of the shear stresses in the plane in question, including direct vertical shear due to three times the static vertical loading, direct lateral shear due to a lateral accelerative force of twice the static weight, and torsional shear due to a lateral accelerative force equal to twice the static weight, applied at the road surface. Maximum concentrated stresses which might be created at pads and cradles due to shear, bending, and torsion shall also be calculated in accordance with appendix G of the ASME Code, 1962 edition.

NOTE 1: The forces, loads, and stresses concerned in the foregoing requirement relate to the weight of the tank itself, its contents, and articles supported by the tank, not including the weight of structures supporting the tank in normal operating condition. The stresses involved are not all uniform through the length of the tank shell.

(c) Where any tank support is attached to any part of a tank head, the stresses imposed upon the head must be as required in paragraph (b) of this section with respect to maximum concentrated stresses at pads and cradles.

[Amdt. 178-3, 34 FR 7164, May 1, 1969; 34 FR 7332 May 6, 1969]

§ 178.337-4 Joints.

(a) Joints shall be as required by the ASME Code, with all undercutting in shell and head material repaired as specified therein.

(b) Welding procedure and welder performance tests must be made annually in accordance with Section IX of the ASME Code. In addition to the essential variables named therein, the following must be considered as essential variables: Number of passes; thickness of plate; heat input per pass; and manufacturer's identification of rod and flux. When fabrication is done in accordance with Part UHT of the ASME Code, filler material containing more than 0.08 percent vanadium must not be used. The number of passes, thickness of plate, and heat input per pass may not vary more than 25 percent from the procedure or welder qualifications. Records of the qualifications must be retained for at least 5 years by the tank manufacturer and must be made available to duly identified representatives of the Department and the owner of the tank.

(c) All longitudinal shell welds shall be located in the upper half of the tank.

(d) Edge preparation of shell and head components may be by machine heat processes, provided such surfaces are remelted in the subsequent welding process. Where there will be no subsequent remelting of the prepared surface as in a tapered section, the final 0.050 inch of material shall be removed by mechanical means.

(e) The maximum tolerance for misalignment and butting up shall be in accordance with the ASME Code.

(f) Substructures shall be properly fitted before attachment, and the welding sequence shall be such as to minimize stresses due to shrinkage of welds.

[Order 59-B, 30 FR 580, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.337-4 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.337-5 Bulkheads, baffles and ring stiffeners.

(a) Not a specification requirement.

[Order 59-B, 30 FR 580, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.337-6 Closure for manhole.

(a) Each tank constructed in accordance with Part UHT of the ASME Code and other tanks above 3,500 gallons water capacity must be provided with a manhole conforming to paragraph UG-46(g)(1) and other requirements of the ASME Code.

(b) The manhole assembly of cargo tanks constructed after June 30, 1979, may not be located on the front head of the tank.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 178-7, 34 FR 18250, Nov. 14, 1969, as amended by Amdt. 178-52, 43 FR 58820, Dec. 18, 1978]

§ 178.337-7 Overturn protection.

(a) See § 178.337-10.

[Order 59-B, 30 FR 580, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.337-8 Outlets.

(a) *Outlets generally.* (1) An opening shall be provided on each tank used for the transportation of liquefied materials to afford complete drainage.

(2) With the exception of gauging devices, thermometer wells, and safety relief valves, every opening in every tank used for the transportation of compressed gases other than carbon dioxide shall be (i) closed with a plug, cap, bolted flange, or plate or (ii) protected with an excess flow valve or back flow check valve (see § 178.337-11(a)) or (iii) be fitted with a remote control valve as specified in § 178.337-11(c).

(b) *Chlorine tank valves.* See § 173.33 (f)(9), (h) (4), and (5) of this subchapter. Regarding chlorine tank outlets, see also § 178.337-1(c)(2) of this part.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 (e))

[Order 59-B, 30 FR 580, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.337-8 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.337-9 Safety relief devices, valves and connections.

(a) *Safety relief valves.* (1) See § 173.315(i) of this subchapter.

(2) On tanks for carbon dioxide or nitrous oxide see § 173.315 (i) (9) and (10) of this subchapter.

(3) Each valve must be designed, constructed, and marked for a rated pressure not less than the tank design pressure at the temperature expected to be encountered.

(b) *Piping, valves, and fittings.* (1) See § 173.33(f) (1) and (3) of this subchapter.

(2) Piping and fittings must be in conformance with § 173.33(f) of this subchapter and must be protected from damage as required by § 178.337-10 of this section.

(c) *Marking inlets and outlets.* All tank inlets and outlets, except safety relief valves, shall be marked to designate whether they communicate with vapor or liquid when the tank is filled to the maximum permitted filling density.

(d) *Refrigeration and heating coils.* (1) Refrigeration and heating coils, when installed in any tank, shall be securely anchored with provision for thermal expansion. They shall be tested externally to at least the tank test pressure, and internally to at least the tank test pressure or at least twice the working pressure of the heating or refrigeration system, if higher, and the tank shall not be placed in or returned to transportation service if any leakage or other evidence of damage is found in these tests. The refrigerant or heating medium to be circulated through the coils must be such as to cause no adverse chemical reaction with the tank or tank contents in case of leakage.

(2) Where any liquid susceptible to freezing, or the vapor of any such liquid, is used for heating or refrigeration, the heating or refrigeration system shall be arranged to permit complete drainage.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Order 59-B, 30 FR 580, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.337-9 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.337-10 Protection of fittings.

(a) All valves, fittings, safety relief devices, and other accessories to the tank proper shall be protected in accordance with paragraph (b) of this section against such damage as could be caused by collision with other vehicles or objects, jackknifing and overturning. In addition, safety relief valves shall be so protected that in the event of overturn of the vehicle on to a hard surface, their opening will not be prevented and their discharge will not be restricted.

(b) The protective devices or housing must be designed to withstand static loading in any direction equal to twice the weight of the tank and attachments when filled with the lading, using a safety factor of not less than four, based on the ultimate strength of the material to be used, without damage to the fittings protected, and must be made of metal at least 3/16-inch thick.

(c) *For chlorine tanks.* There shall be a protective housing and manway cover to permit the use of standard emergency kits for controlling leaks in fittings on the dome cover plate. The housing and manway cover must conform to the Chlorine Institute's standards as follows:

(1) Tanks manufactured on or before December 31, 1974: Dwg. 137-1, dated November 7, 1962, or Dwg. 137-2, dated September 1, 1971.

(2) Tanks manufactured on or after January 1, 1975: Dwg. 137-2, dated September 1, 1971.

(d) Each tank motor vehicle shall be provided with at least one rear bumper designed to protect the tank and piping in the event of a rear end collision and minimize the possibility of any part of the colliding vehicle striking the tank. The design shall be such as to transmit the force of a rear end collision in a horizontal line to the chassis of the vehicle. The bumper shall be designed to withstand the impact of the fully loaded vehicle with a deceleration of 2 "g", using a safety factor of four based on the ultimate strength of the bumper material. The bumpers shall conform dimensionally to § 393.86, Chapter III of this title.

[Order 59-B, 30 FR 581, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.337-10 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.337-11 Emergency discharge control.

(a) *Excess flow valves and back flow check valves.* (1) Where used as required in § 178.337-8(a) (2) excess flow valves or back flow check valves shall be located inside the tank or inside a welded nozzle which is an integral part of the tank.

(2) Excess flow valves must be in conformance with § 173.33(h) of this subchapter.

(3). Chlorine tanks. See § 173.33(h) (4) of this subchapter.

(b) *Shutoff valves.* See § 173.33(h)(3) of this subchapter.

(c) *Liquid or vapor discharge openings.* Except for an engine fuel line on a truck-mounted tank, of not over 3/4-inch diameter and equipped with a valve having an integral excess flow valve, each liquid or vapor discharge opening in a tank used for a flammable liquid, flammable compressed gas, or anhydrous ammonia must be equipped with a remotely controlled internal shut-off valve. However, on any liquid or vapor discharge opening of less than 1¼-inches diameter, an excess flow valve together with a manually operated external valve may be used in place of a remotely controlled internal shut-off valve. Each remotely controlled internal valve must be in conformance with the following requirements:

(1) The seat of the valve shall be inside the tank, or in the opening nozzle or flange or in a companion flange bolted to the nozzle or flange.

(2) All parts of the valve inside the tank, nozzle, or companion flange, shall be made of material not subject to corrosion or other deterioration in the presence of the lading.

(3) The arrangement of parts shall be such that damage to parts exterior to the tank will not prevent effective seating of the valve.

(4) The valve may be operated normally by mechanical means, by hydraulic means, or by air, or gas pressure.

(5) On a tank over 3,500 gallons water capacity, each internal shut-off valve must be provided with remote means of automatic closure, both mechanical and thermal, that are installed at the ends of the tank in at least two, diagonally opposite locations. If the discharge connection at the tank is not in the general vicinity of one of the two locations specified above, one additional fusible element must be installed so that heat from a fire in that area will activate the emergency control system. Fusible elements may not have a melting point exceeding 250° F.

(6) On a tank of 3,500 gallons water capacity or less, each internal shut-off valve must be provided with at least one remote control station, and the actuating means may be mechanical. This station must be at one end of the tank, away from the discharge connection area.

(49 U.S.C. 1803; 1804, 1808; 49 CFR 1.53(e))

[Order 59-B, 30 FR 581, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.337-11 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.337-12 Shear section.

(a) Design or installation of valves specified in § 178.337-8(a)(2) shall provide adjacent to and outboard of such valves a section which will break under undue strain.

[Order 59-B, 30 FR 581, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.337-13 Supporting and anchoring.

(a) A cargo tank that is not permanently attached to or integral with a vehicle chassis must be secured by turnbuckles or equally efficient securing devices for drawing the tank down tight on the frame. Anchors, stops, or other means must be provided to prevent relative motion between the tank and the vehicle chassis when the vehicle is in operation.

(b) A tank motor vehicle designed and constructed so that the cargo tank constitutes in whole or in part the stress member used in place of a frame must have the tank supported by external cradles. A cargo tank mounted on a frame must be supported by external cradles or longitudinal members. The cradles, where used, must subtend at least 120 degrees of the shell circumference. The design calculations for the supports must include beam stress, shear stress, torsion stress, bending moment, and acceleration stress, for the loaded vehicle as a unit, using a factor of safety of 4, based on the ultimate strength of the material and on a 2 "g" longitudinal and lateral loading and 3 times the static weight in vertical loading (see Appendix G of the ASME Code).

(c) Where any tank support is attached to any part of a tank head, the stresses imposed upon the head shall be provided for as required in paragraph (b) of this section.

(d) No tank support or bumper may be welded directly to the tank. All supports and bumpers shall be attached by means of pads of the same material as the tank. The pad thickness shall be no less than ¼ inch, or the thickness of the shell material if less, and no greater than the shell material. Each pad shall extend at least 4 times its thickness, in each direction, beyond the weld attaching the support or bumper. Each pad shall be preformed to an inside radius no greater than the outside radius of the tank at the place of attachment. Each pad corner shall be rounded to a radius at least one-fourth the width of the pad, and no greater than one-half the width of the pad. Weep holes and telltale holes, if used shall be drilled or punched before the pads are attached to the tank. Each pad shall be attached to the tank by continuous fillet welding using filler material having properties conforming to the recommendations of the maker of the shell and head material.

[Order 59-B, 30 FR 581, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-29, 38 FR 27598, Oct. 5, 1973]

§ 178.337-14 Gauging devices.

(a) *Liquid level gauging devices.* See § 173.315(h) of this subchapter.

(b) *Pressure gauges.* See §§ 173.33(f)(7) and 173.315(h) of this subchapter.

(c) *Orifices.* See § 173.315(h) (3) and (4) of this subchapter.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 178-29, 38 FR 27599, Oct. 5, 1973 as amended by Amdt. 178-51, 43 FR 48646, Oct. 19, 1978]

§ 178.337-15 Pumps and compressors.

See § 173.33(f) (6) and (10) of this subchapter.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 178-29, 38 FR 27599, Oct. 5, 1973 as amended by Amdt. 178-51, 43 FR 48646, Oct. 19, 1978]

§ 178.337-16 Testing.

(a) *Inspection and tests.* Inspection of materials of construction of the tank and its appurtenances and original test and inspection of the finished tank and its appurtenances must be as required by the ASME Code and as further required by this specification except that for tanks constructed in accordance with Part UHT of the ASME Code the original test pressure must be at least twice the tank design pressure.

(b) *Weld testing and inspection.* (1) Each tank constructed in accordance with Part UHT of the ASME Code must be subjected, after postweld heat treatment and hydrostatic tests, to a wet fluorescent magnetic particle inspection to be made on all welds in or on the tank shell and heads both inside and out. The method of inspection must conform to Appendix VI of the ASME Code, paragraph UA-70 through UA-72 except that permanent magnets shall not be used.

(2) On tanks of over 3,500 gallons water capacity other than those describe in paragraph (b)(1) of this section unless fully radiographed, a test must be made of all welds in or on the shell and heads both inside and outside by either the wet fluorescent magnetic particle method conforming to Appendix VI of the ASME Code, liquid dye penetrant method, or ultrasonic testing in accordance with Appendix U of the ASME Code. Permanent magnets must not be used to perform the magnetic particle inspection.

(c) All defects found shall be repaired, the tanks shall then again be postweld heat treated, if such heat treatment was previously performed, and the repaired areas shall again be tested.

[Order 59-B, 30 FR 582, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18250, Nov. 14, 1969]

§ 178.337-17 Marking.

(a) *Metal identification plate.* Each tank shall have a noncorrosive metal plate permanently affixed by brazing or welding around its perimeter, on the right side near the front, in a place readily accessible for inspection and maintained legible. On multitank vehicles plates shall be attached to each tank at the front in a place readily accessible for inspection. Each insulated tank shall have an additional plate, as described, affixed to the jacket in the location specified. Neither the plate itself nor the means of attachment to the tank or jacket may be subject to attack by the tank contents. If the plate is attached directly to the tank by welding it shall be welded thereto before the tank is postweld heat treated. The plate shall be plainly marked by stamping, embossing, or other means of forming letters into the metal of the plate, with the following information in addition to that required by the ASME Code, in characters at least ⅜ inch high:

Vehicle manufacturer.
Vehicle manufacturer's serial number.
D.O.T. specification number MC-331.
Vessel material specification number.
Water capacity in pounds (see Note 1).
Original test date.

NOTE 1: See § 173.315(a) of this chapter regarding water capacity.

(b) Each tank motor vehicle must also be marked as required by § 172.328 of this subchapter.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Order 59-B, 30 FR 582, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.337-17 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.337-18 Certification.

(a) For each tank the tank vehicle manufacturer shall supply and the owner shall obtain the tank manufacturer's data report required by the ASME Code, and a certificate stating that the completed tank vehicle is in complete compliance in all respects with specification MC 331 including the ASME Code. The certificate must be signed by a responsible official of the fabricating firm. The certificate must state whether or not it includes certification that all valves, piping, and protective devices comply with the requirements of the specification. If it does not so certify, the installer of any such valve, piping, or device shall supply and the owner shall obtain a certificate asserting complete compliance with these specifications for such devices. The certificate, or certificates, will include sufficient sketches, drawings, and other information to indicate the location, make, model, and size of each valve and the arrangement of all piping associated with the tank.

(1) The certificate must contain a statement indicating whether or not the cargo tank was postweld heat treated for anhydrous ammonia as specified in § 178.337-1(f).

(b) The owner shall retain the copy of the data report and certificates and related papers in his files throughout his ownership of the tank and for at least one year thereafter; and in the event of change in ownership, retention by the prior owner of nonfading photographically reproduced copies will be deemed to satisfy this requirement. Each motor carrier using the tank, if not the owner thereof, shall obtain a copy of the data report and certificate and retain them in his files during the time he uses the tank and for at least one year thereafter.

[Order 59-B, 30 FR 583, Jan. 16, 1965. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.337-18 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.340 General design and construction requirements applicable to specifications MC 306 (§ 178.341), MC 307 (§ 178.342), and MC 312 (§ 178.343) cargo tanks.

[Order 73, 32 FR 3459, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.340-1 Specification requirements for MC 306, MC 307, and MC 312 cargo tanks.

(a) Specifications MC 306, MC 307, and MC 312 cargo tanks constructed on or after December 1, 1967, for the bulk transportation of hazardous materials must meet the requirements contained in this section in addition to the requirements of each applicable specification as contained in § 178.341 (MC 306), § 178.342 (MC 307), and § 178.343 (MC 312).

(b) All of these specification requirements are minimum requirements.

[Order 73, 32 FR 3459, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.340-2 General requirements.

(a) Every cargo tank and vessel shall be designed and constructed in accordance with the best known and available practices in addition to the other applicable cargo tank specification requirements.

(b) Those requirements relating to parts and accessories applicable to all motor vehicles engaged in interstate commerce as contained in Part 393 of the Motor Carrier Safety Regulations of this title are an integral part of this specification.

(c) Where applicable the additional requirements prescribed in Part 173 of this chapter to accommodate specific commodities are considered an integral part of these specifications.

(d) Multipurpose cargo tank:

(1) A single cargo tank may be divided into compartments of different specification construction. Each such compartment shall conform to specification requirements concerned.

(2) A single cargo tank may be physically altered to comply with another cargo tank specification in the regulations in this part; or altered to accommodate a commodity not requiring a DOT specification tank.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Order 73, 32 FR 3459, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-21, 36 FR 18469, Sept. 15, 1971; Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

§ 178.340-3 Material.

(a) All sheet and plate material for shell, heads, bulkheads and baffles for cargo tanks which are not required to be constructed in accordance with the American Society of Mechanical Engineers' Boiler and Pressure Vessel Code shall meet the following minimum applicable requirements:

(1) *Aluminum Alloys (AL).* Only aluminum alloy material suitable for fusion welding and in compliance with one of the following ASTM specifications shall be used:

ASTM B-209 Alloy 5052.
ASTM B-209 Alloy 5086.
ASTM B-209 Alloy 5154.
ASTM B-209 Alloy 5254.
ASTM B-209 Alloy 5454.
ASTM B-209 Alloy 5652.

All heads, bulkheads, baffles, and rings stiffeners may use 0 temper (annealed) or stronger tempers. All shells shall be made of materials with properties equivalent to H32 or H34 tempers, except that lower ultimate strength tempers may be used if the minimum shell thicknesses in Table II in § 178.341-2, § 178.342-2, or § 178.343-2 are increased in inverse proportion to the lesser ultimate strength.

(2) *Steel.*

	Mild steel (MS)	High strength low alloy steel (HSLA)	Austenitic stainless steel (SS)
Yield point, p.s.i	25,000	45,000	25,000
Ultimate strength, p.s.i	45,000	60,000	70,000
Elongation, 2-inch samples, percent	20	25	30

[Order 73, 32 FR 3460, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.340-4 Structural integrity.

(a) *Maximum stress values.* The maximum calculated stress value must not exceed 20 percent of the minimum ultimate strength of the material as authorized in § 178.340-3, except when ASME Code pressure vessel design requirements apply.

(b) *Loadings.* Cargo tanks shall be provided with additional structural elements as necessary to prevent resulting stresses in excess of those permitted in paragraph (a) of this section. Consideration shall be given to forces imposed by each of the following loads individually, and where applicable a vector, summation of any combination thereof:

(1) Dynamic loading under all product load configurations.

(2) Internal pressure.

(3) Superimposed loads such as operating equipment, insulation, linings, hose tubes, cabinets, and piping.

(4) Reactions of supporting lugs and saddles or other supports.

(5) Effect of temperature gradients resulting from product and ambient temperature extremes. Thermal coefficients of dissimilar materials where used should be accommodated.

[Order 73, 32 FR 3460, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18251, Nov. 14, 1969]

§ 178.340-5 Joints.

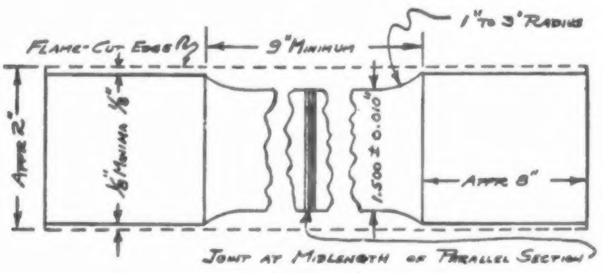
(a) *Method of joining.* All joints between tank shells, heads, baffles (or baffle attaching rings), and bulkheads shall be welded in accordance with the requirements contained in this section.

(b) *Strength of joints (Aluminum Alloy (AL)).* All welded aluminum alloy joints shall be made in accordance with recognized good practice, and the efficiency of a joint shall be not less than 85 percent of the properties of the adjacent material. Aluminum alloys shall be joined by an inert gas arc welding process using aluminum-magnesium type of filler metals which are consistent with the material suppliers recommendations.

(c) *Strength of joints (Mild Steel (MS), High Strength Low Alloy (HSLA), Austenitic Stainless Steel (SS)).* Joints shall be welded in accordance with recognized good practice and the efficiency of any joint shall be not less than 85 percent of the mechanical properties of the adjacent metal in the tank.

(1) Combinations of mild steel (MS), high strength low alloy (HSLA) and/or austenitic stainless steel (SS), may be used in the construction of a single tank, provided that each material, where used, shall comply with the minimum requirements specified in § 178.340-3(a) for the material used in the construction of that section of the tank. Whenever stainless steel sheets are used in combination with sheets or other types of steel, joints made by welding shall be formed by the use of stainless steel electrodes or filler rods and the stainless steel electrodes or filler rods used in the welding shall be suitable for use with the grade of stainless steel concerned, according to the recommendations of the manufacturer of the stainless steel electrodes or filler rods.

(d) *Compliance test.* Compliance with the requirements contained in paragraph (b) or (c) of this section for the welded joints indicated in paragraph (a) of this section shall be determined by preparing from materials representative of those to be used in tanks subject to this specification and by the same technique of fabrication, two test specimens conforming to figure as shown below and testing them to failure in tension. One pair of test specimens may represent all the tanks to be made of the same combination of materials by the same technique of fabrication, and in the same shop, within 6 months after the tests on such samples have been completed. The butt welded specimens tested shall be considered qualifying other types or combinations of types of weld using the same filler material and welding process as long as parent metals are of the same types of material.



Tensile Specimen

[Order 73, 32 FR 3460, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.340-6 Supports and anchoring.

(a) Cargo tanks with frames not made integral with the tanks as by welding, shall be provided with restraining devices to eliminate any relative motion between the tank and frame which may result from the stopping, starting or turning of the vehicle. Such restraining devices shall be readily accessible for inspection and maintenance; except that insulation and jacketing are permitted to cover the restraining devices.

(b) Any cargo tank designed and constructed so that it constitutes in whole or in part the structural member used in lieu of a frame, shall be supported in such a manner that the resulting stress levels in the cargo tank do not exceed those specified in

§ 178.340-4(a). The design calculations of the support elements shall include loadings imposed by stopping, starting and turning in addition to those imposed as indicated in § 178.340-4(b) using 20 percent of the minimum ultimate strength of the support material.

[Order 73, 32 FR 3460, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.340-7 Circumferential reinforcements.

(a) Tanks with shell thicknesses less than three-eights of an inch shall in addition to the tank heads be circumferentially reinforced with either bulkheads, baffles, or ring stiffeners. It is permissible to use any combination of the aforementioned reinforcements in a single cargo tank.

(1) *Location.* Such reinforcement shall be located in such a manner that the maximum unreinforced portion of the shell be as specified in Table II of the applicable specification and in no case more than 60 inches. Additionally such circumferential reinforcement shall be located within 1 inch of points where discontinuity in longitudinal shell sheet alinement exceeds 10 degrees unless otherwise reinforced with structural members capable of maintaining shell sheet stress levels permitted in § 178.340-4(a).

(b) *Baffles:* Baffles or baffle attaching rings if used as reinforcement members shall be circumferentially welded to the tank shell. The welding must not be less than 50 percent of the total circumference of the vessel and the maximum unwelded space on this joint shall not exceed 40 times the shell thickness.

(c) *Double bulkheads:* Tanks designed to transport different commodities which if combined during transit will cause a dangerous condition or evolution of heat or gas shall be provided with compartments separated by an air space. This air space shall be vented and be equipped with drainage facilities which shall be kept operative at all times.

(d) *Ring stiffeners:* Ring stiffeners when used to comply with this section shall be continuous around the circumference of the tank shell and shall have a section modulus about the neutral axis of the ring section parallel to the shell at least equal to that determined by the following formula:

I/C (Min)=0.00027 WL (MS, HSLA, and SS) Steel

I/C (Min)=0.000467 WL (AL) Aluminum Alloy

where:

I/C=Section modulus (inches^3).

W=Tank width or diameter (inches).

L=Ring spacing (inches); i.e., the maximum distance from the midpoint of the unsupported shell on one side of the ring stiffener to the midpoint of the unsupported shell on the opposite side of the ring stiffener.

(1) If a ring stiffener is welded to the tank shell (with each circumferential weld not less than 50 percent of the total maximum unwelded space on this joint not exceeding 40 times the shell thickness) a portion of the shell may be considered as part of the ring section for purposes of computing the ring section modulus. The maximum portion of the shell to be used in these calculations is as follows:

Circumferential ring stiffener to tank shell welds	Distance between parallel circumferential ring stiffener to shell welds	Shell section credit
1		20*t*.
2	Less than 20*t*.	20*t*+*W*.
2	20*t* or more	40*t*.

where:

t=Shell thickness.

W=Distance between parallel circumferential ring stiffener to shell welds.

(2) If configuration of internal or external ring stiffener encloses an air space, this air space shall be arranged for venting and be equipped with drainage facilities which shall be kept operative at all times.

[Order 73, 32 FR 3460, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.340-8 Accident damage protection.

(a) *Appurtenances:* The term "appurtenance" means any cargo tank accessory attachment that has no liquid product retention or other liquid containment function, and provides no structural support to the tank.

(1) The design, construction, and installation of any appurtenance to the

shell or head of the cargo tank must be such as to minimize the possibility of appurtenance damage or failure adversely affecting the product retention integrity of the tank.

(2) Structural members, such as the suspension subframe, overturn protection and external rings, when practicable, should be utilized as sites for attachment of appurtenances and any other accessories to a cargo tank.

(3) Except as prescribed in paragraph (a)(5) of this section, the welding of any appurtenance to a shell or head must be made by attachment of a mounting pad. The thickness of a mounting pad must not be less than that of the shell or head to which it is attached. A pad must extend at least 2 inches in each direction from any point of attachment of an appurtenance. Pads must have rounded corners or otherwise be shaped in a manner to preclude stress concentrations on the shell or head. The mounting pad must be attached by a continuous weld around the pad.

(4) The appurtenance must be attached to the mounting pad so there will be no adverse affect upon the product-retention integrity of the tank if any force is applied to the appurtenance, in any direction, except normal to the tank, or within 45° of normal.

(5) Skirting structures, conduit clips, brakeline clips, and similar lightweight attachments, which are of a metal thickness, construction, or material, appreciably less strong but not more than 72 percent of the thickness of the tank shell or head to which such a device is attached, may be secured directly to the tank shell or head if each device is so designed and installed that damage to it will not affect the product retention integrity of the tank. These lightweight attachments must be secured to the tank shell by continuous weld or in such manner as to preclude formation of pockets, which may become sites for incipient corrosion.

(b) *Rear bumpers:* Every cargo tank shall be provided with a rear bumper to protect the tank and piping in the event of a rear end collision and minimize the possibility of any part of the colliding vehicle striking the tank. The bumper shall be located at least 6 inches to the rear of any vehicle component which is used for loading or unloading purposes or may at any time contain lading while in transit. Dimensionally, the bumper shall conform to § 393.86 of this title. Structurally, the bumper shall be designed to successfully absorb (no damage which will cause leakage of product) the impact of the vehicle with rated payload, with a deceleration of 2 "g" using a factor of safety of two based on the ultimate strength of the bumper material. For purposes of the regulations in this part such impact shall be considered uniformly distributed and applied horizontally (parallel to the ground) from any direction at an angle not exceeding 30° to the longitudinal axis of the vehicle.

(c) *Overturn protection:* All closures for filling, manhole, or inspection openings shall be protected from damage which will result in leakage of lading in the event of overturning of the vehicle by being enclosed within the body of the tank or dome attached to the tank or by guards.

(1) When guards are required, they shall be designed and installed to withstand a vertical load of twice the weight of the loaded tank and a horizontal load in any direction equivalent to one-half the weight of the loaded tank. These design loads may be considered independently. Ultimate strength of the material shall be used as a calculation base. If more than one guard is used each shall carry its proportionate share of the load. If protection other than guards are considered the same design load criteria is applicable.

(2) Except for pressure actuated vents no overturn protection is required for nonoperating nozzles or fittings less than 5 inches in diameter (which do not contain product while in transit) that project a distance less than the inside diameter of the fitting. This projected distance may be measured either from the shell or the top of an adjacent ring stiffener provided such stiffener is within 30 inches of the center of the nozzle or fitting.

(3) If the overturn protection is so constructed as to permit accumulation of liquid on the top of the tank, it shall be provided with drainage facili-

ties directed to a safe point of discharge.

(d) *Piping:* (1) Product discharge piping shall be provided with protection in such a manner as to reasonably assure against the accidental escape of contents. Such protection may be provided by:

(i) A shear section located outboard of each emergency valve seat and within 4 inches of the vessel which will break under strain and leave the emergency valve seat and its attachment to the vessel and the valve head intact and capable of retaining product. The shear section shall be machined in such a manner as to abruptly reduce the wall thickness of the adjacent piping (or valve) material by at least 20 percent; or

(ii) By suitable guards capable of successfully absorbing a concentrated horizontal force of at least 8,000 pounds applied from any horizontal direction, without damage to the discharge piping which will adversely affect the product retention integrity of the discharge valve.

(2) Minimum road clearance: The minimum allowable road clearance of any cargo tank component or protection device located between any two adjacent axles on a vehicle or vehicle combination shall be at least one-half inch for each foot separating such axles and in no case less than 12 inches.

(3) Strength of piping, fittings, hose and hose couplings: Hose, piping, and fittings for tanks to be unloaded by pressure shall be designed for a bursting pressure of at least 100 p.s.i.g. and not less than four times the pressure to which, in any instance, it may be subjected in service by the action, of any vehicle mounted pump or other device (not including safety relief valves), the action of which may be to subject certain portions of the tank piping and hose to pressures greater than the design pressure of the tank. Any coupling used on hose to make connections shall be designed for a working pressure not less than 20 percent in excess of the design pressure of the hose and shall be so designed that there will be no leakage when connected.

(4) Provision for expansion and vibration: Suitable provisions shall be made in every case to allow for and prevent damage due to expansion, contraction, jarring, and vibration of all pipe. Slip joints shall not be used for this purpose.

(5) Heater coils: Heaer coils, when installed, shall be so constructed that the breaking off of their external connections will not cause leakage of contents of tank.

(6) Gauging, loading, and air-inlet devices: Gauging, loading, and air-inlet devices, including their valves, shall be provided with adequate means for their secure closure, and means shall also be provided for the closing of pipe connections of valves.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Order 73, 32 FR 3461, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.340-8 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.340-9 Pumps.

(a) Loading or unloading pumps mounted on tractor or trailer, if used, shall be provided with automatic means to prevent the pressure from exceeding the design pressure of the tank mounted equipment.

[Order 73, 32 FR 3462, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.340-10 Certification.

(a) Certification as required in paragraphs (b) and (c) of this section shall indicate that such cargo tank has been designed, constructed, and tested in accordance with the applicable specification MC 306, MC 307, or MC 312 (§ 178.341, § 178.342 or § 178.343).

(1) *Multipurpose tanks.* If a cargo tank is divided into compartments and each compartment is constructed in accordance with the requirements of a different MC specification, there shall be a metal plate required in paragraph (b) of this section, located on the right side, near the front of each compartment, in a place readily accessible for inspection. Details pertaining to the multipurpose configuration shall also be clearly indicated on the manufac-

turer's certificate required in paragraph (c) of this section.

(i) If a cargo tank is constructed in accordance with the requirements of one specification and may be physically altered to meet another cargo tank specification in this part; or physically altered to accommodate, a commodity not requiring a specification tank, such alterations shall be clearly indicated on the manufacturer's certificate required in paragraph (c) of this section and the tank mounted multipurpose plate required in paragraph (b)(2) of this section.

(2) *Specification shortages.* If, a cargo tank is manufactured which does not meet all of the applicable specification requirements, thereby requiring subsequent manufacturing involving the installation of additional components, parts, appurtenances or accessories, it is permissible for the original manufacturer to affix the metal certification plate required in paragraph (b) of this section. The specification requirements not complied with shall be indicated on the manufacturer's certificate required in paragraph (c) of this section. When the cargo tank is finally brought into complete compliance, the date such compliance is accomplished shall be stamped on the metal certification plate. The certificate shall indicate the pertinent details, date and concern (manufacturer or carrier) accomplishing complete compliance.

(b) *Metal certification plate.* Each cargo tank, or tank compartment if constructed to a different specification, must have a metal certification plate attached to its shell or to an integral supporting structure. The metal certification plate, not subject to corrosion, must be located on the right side, near the front, in a place readily accessible for inspection. Each plate shall be permanently affixed by means of brazing, welding, soldering, riveting, or other equally suitable means. The plate must be marked in characters at least 3/16-inch high by stamping, embossing, or other means of forming letters into or on the metal of the plate itself at least the information prescribed in paragraphs (b) (1) and (2) of this section. The plate may not be painted as to obscure the marking thereon. A combination ASME/DOT certification plate is authorized.

(1) If a cargo tank is to be physically altered to meet another specification (or to accommodate a commodity not requiring a specification tank) such combinations shall be indicated beside specification identification. Additionally the metal multipurpose plates required in paragraph (b)(2) of this section are required.

Vehicle manufacturer ————————
Specification identification[1] DOT MC 306; or MC 307; or MC 312 ————————
Date of manufacture ————————
Original test date ————————
Certificate date ————————
Design pressure ———————— p.s.i.g.
Test pressure ———————— p.s.i.g.
Head material ————————
Shell material ————————
Weld material ————————
Lining material ————————
Nominal tank capacity by compartment (front to rear) ———————— U.S. gal.
Maximum product load ———————— lbs.
Loading limits ——— g.p.m. and/or p.s.i.g.
Unloading limits ——— g.p.m. and/or p.s.i.g.

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[1] The following material designations (or combinations thereof) must be added: Aluminum Alloy (AL); Mild Steel (MS); High Strength Low Alloy (HSLA); Austenitic Stainless Steel (SS). For example "DOT MC 306-AL" for cargo tanks made of aluminum. A multipurpose cargo tank example would be "Combination MC 306SS-307SS."

(2) *Metal multipurpose plate:* If a cargo tank is to be physically altered, metal multipurpose plates shall be mounted adjacent to the metal certification plate readily accessible for inspection. The mounting of the plates shall be such that only the plate identifying the applicable specification is legible at all times the cargo tank is in complete compliance with such specifications. The mounting of the plates (or plate assembly) shall be secured in such a manner as to be capable of retaining the plate when subjected to normal operating conditions. The same marking size and method used on the certification plate shall be used. The plate shall contain at least the information contained below:

SPECIFICATION IDENTIFICATION MC ——

EQUIPMENT NECESSARY

	Quantity[1]
Vents:	
Pressure actuated	
Fusible	
Frangible	
Product discharge:	
Top	
Bottom	
Pressure unloading fitting	
Covers:	
Manhole	
Fill openings	

[1] The number required to meet applicable specification. If no physical change is required the letters NC shall follow the number required. If carge tank is not so equipped the word "NONE" shall be inserted.

(i) *Color coding.* Those parts which must be changed or added to meet the applicable specification requirements and the appropriate multi-purpose plate shall be identified using the following colors:

MC 306	RED.
MC 307	GREEN.
MC 312	YELLOW.
Nonspecification	BLUE.

Additionally those parts to be changed or added shall be stamped with the appropriate MC Specification No. ——

(c) *Manufacturer's certificate:* A certificate signed by a responsible official of the manufacturer of the cargo tank, or from a competent testing agency, certifying that each such cargo tank is designed, constructed and tested in accordance and complies with the requirements contained in the applicable specification shall be procured, and such certificate shall be retained in the files of the carrier during the time that such cargo tank is employed by him plus one year. In lieu of this certificate, if the motor carrier himself elects to ascertain that any such tank fulfills the requirements of the specification by his own test, he shall similarly retain the test data.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Order 73, 32 FR 3462, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 178.340-10 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 178.341 Specification MC 306; cargo tanks.

[Order 73, 32 FR 3462, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.341-1 General requirements.

(a) Specification MC 306 cargo tanks must comply with the general design and construction requirements in § 178.340 in addition to the specific requirements contained in this section.

(b) Design pressure: The design pressure of each cargo tank shall be not less than that pressure exerted by the static head of the fully loaded tank in the upright position.

[Order 73, 32 FR 3462, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.341-2 Thickness of shells, heads, bulkheads, and baffles.

(a) *Material thickness.* The minimum thicknesses of tank material authorized in § 178.340-3 shall be predicated on not exceeding the maximum allowable stress level (§ 178.340-4(a)) but in no case less than those indicated in Tables I and II below:

TABLE I—MINIMUM THICKNESS OF HEADS, BULKHEADS AND BAFFLES. MILD STEEL (MS), HIGH STRENGTH LOW ALLOY STEEL (HSLA). AUSTENITIC STAINLESS STEEL (SS), IN U.S. STANDARD GAUGE; ALUMINUM ALLOY (AL)—EXPRESSED IN DECIMALS OF AN INCH

	Volume capacity in gallons per inch											
	10 or less			Over 10 to 14			14 to 18			18 and over		
	MS	HSLA, SS	AL	MS	HSLA, SS	AL	MS	HSLA, SS	AL	MS	HSLA, SS	AL
Thickness	14	15	0.096	13	14	0.109	12	13	0.130	11	12	0.151

TABLE II—MINIMUM THICKNESS OF SHELL SHEETS, MILD STEEL (MS), HIGH STRENGTH LOW ALLOY STEEL (HSLA), AUSTENITIC STAINLESS STEEL (SS) IN U.S. STANDARD GAUGE; ALUMINUM ALLOY (AL)—EXPRESSED IN DECIMALS OF AN INCH

Distances between bulkheads, baffles, or ring stiffeners	Volume capacity in gallons per inch											
	10 or less			Over 10 to 14			14 to 18			18 and over		
	MS	HSLA, SS	AL	MS	HSLA, SS	AL	MS	HSLA, SS	AL	MS	HSLA, SS	AL
MAXIMUM SHELL RADIUS LESS THAN 70 INCHES												
36 inches or less	14	16	0.087	14	16	0.087	14	15	0.096	13	14	0.109
Over 36 inches to 54 inches	14	16	.087	14	15	.096	13	14	.109	12	13	.130
54 inches through 60 inches	14	15	.096	13	14	.109	12	13	.130	11	12	.151
70 INCHES OR MORE, LESS THAN 90 INCHES												
36 inches or less	14	16	.087	14	15	.096	13	14	.109	12	13	.130
Over 36 inches to 54 inches	14	15	.096	13	14	.109	12	13	.130	11	12	.151
54 inches through 60 inches	13	14	.109	12	13	.130	11	12	.151	10	11	.173
90 INCHES OR MORE, LESS THAN 125 INCHES												
36 inches or less	14	15	.096	13	14	.109	12	13	.130	11	12	.151
Over 36 inches to 54 inches	13	14	.109	12	13	.130	11	12	.151	10	11	.173
54 inches through 60 inches	12	13	.130	11	12	.151	10	11	.173	9	10	.194
125 INCHES OR MORE												
36 inches or less	13	14	.109	12	13	.130	11	12	.151	10	11	.173
Over 36 inches to 54 inches	12	13	.130	11	12	.151	10	11	.173	9	10	.194
54 inches through 60 inches	11	12	.151	10	11	.173	9	10	.194	8	9	.216

(1) *Product density.* The material thicknesses contained in Tables I and II are minimums based on a maximum 7.2 pounds per gallon product weight. If the tank is designed to haul products weighing more than 7.2 pounds per gallon, the gallon per inch value used to determine the minimum thickness of heads, bulkheads, baffles or shell sheets shall be the actual section capacity required in gallons per inch multiplied by the actual product density in pounds per gallon divided by 7.2.

[Order 73, 32 FR 3462, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.341-3 Closures for fill openings and manholes.

(a) Each compartment in excess of 2,500 gallons capacity shall be accessible through a manhole of at least 11 × 15 inches. Manhole and/or fill opening covers shall be designed to provide secure closure of the openings. They shall have structural capability of withstanding internal fluid pressures of 9 p.s.i.g. without permanent deformation. Safety devices to prevent the manhole and/or fill cover from opening fully when internal pressure is present shall be provided.

[Order 73, 32 FR 3463, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.341-4 Vents.

(a) Each cargo tank compartment shall be provided with safety relief devices in accordance with the requirements contained in this paragraph. All of such devices shall communicate with the vapor space. Shutoff valves shall not be installed between the tank opening and any safety device. Safety relief devices shall be so mounted, shielded, or drained as to eliminate the accumulation of water, the freezing of which could impair the operation or discharge capability of the device.

(b) *Normal venting:* Each cargo tank compartment shall be provided with pressure and vacuum vents having a minimum through area of 0.44 square inch. All pressure vents shall be set to open at no more than 1 p.s.i.g. and all vacuum vents at no more than 6 ounces. Pressure and vacuum vents shall be designed to prevent loss of liquid through the vent in case of vehicle overturn.

(c) *Loading and unloading venting protection:* If the tank is designed to be loaded or unloaded with the dome cover closed, the vent or vents as described in paragraph (b) of this section or additional vents shall limit the vacuum to 1 p.s.i. and the tank pressure to 3 p.s.i.g. based on maximum product transfer rate to be included on the metal certification plate § 178.340-10(b). Unless effective protection against overfilling is made, the pressure vent shall also have sufficient liquid capacity to prevent the pressure from exceeding 3 p.s.i.g. in case of accidental overfilling. This pressure vent may be pressure operated or interlocked with the tank loading device, and shall be designed to prevent loss of liquid through the vent under any condition of vehicle rollover attitude.

(d) *Emergency venting for fire exposure*—(1) *Total capacity.* The total emergency venting capacity (cu. ft./hr.) of each cargo tank compartment shall be not less than that determined from Table III.

(2) *Pressure-actuated venting.* Each cargo tank compartment shall be equipped with pressure-actuated vent or vents set to open at not less than 3 p.s.i.g. and close when pressure drops to 3 p.s.i.g. or below. The minimum venting capacity for pressure-actuated vents shall be 6,000 cubic feet of free air per hour (14.7 p.s.i.a. and 60° F.) from a tank pressure of 5 p.s.i.g. Pressure-actuated devices shall be designed so as to prevent leakage of liquid past the device in case of surge or vehicle upset, except that they shall function in case of pressure rise under any condition of vehicle rollover attitude.

(3) *Fusible venting.* If the pressure-actuated venting required by paragraph (d)(2) of this section does not provide the total venting capacity required by paragraph (d)(1) of this section additional capacity shall be provided by adding fusible venting devices each having a minimum area of 1.25 square inches, such fusible elements shall be so located as to not be in contact with the tank lading under normal operating conditions. The fusible vent or vents shall be actuated by elements which operate at a temperature not exceeding 250° F. The venting capacity of these devices shall be rated at not more than 5 p.s.i.g.

(e) Flow testing and marking of vents: Each type and size of venting devices shall be flow tested in the ranges specified in the applicable preceding paragraphs. The actual rated flow capacity of the vent in cubic feet of free air per hour at the pressure in p.s.i.g. at which the flow capacity is determined shall be stamped on the device. The fusible vent or vents shall have their flow rating determined at 5 p.s.i.g. differential.

TABLE III—MINIMUM EMERGENCY VENT CAPACITY IN CUBIC FEET; FREE AIR/HOUR (14.7 P.S.I.A. AND 60° F.)

Exposed area square feet	Cubic feet free air per hour
20	15,800
30	23,700
40	31,600
50	39,500
60	47,400
70	55,300
80	63,300
90	71,200
100	79,100
120	94,900
140	110,700
160	126,500
180	142,300
200	158,100
225	191,300
250	203,100
275	214,300
300	225,100
350	245,700
400	265,000
450	283,200
500	300,600
550	317,300
600	333,300
650	348,800
700	363,700
750	378,200
800	392,200
850	405,900
900	419,300
950	432,300
1,000	445,000

NOTE 1: Interpolate for intermediate sizes.

(1) These flow tests may be conducted by the manufacturer or may be delegated to a certified outside agency.

[Order 73, 32 FR 3463, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-25, 36 FR 18469, Sept. 15, 1971]

§ 178.341-5 Emergency flow control.

(a) Each product discharge opening shall be equipped with a self-closing shut off valve, designed, installed, and protected in accordance with § 178.340-8(d) and operated so as to assure against the accidental escape of contents. These valves shall be located inside the tank or at a point outside the tank where the line enters or leaves the tank. The valve seat shall be located inside the tank or within the welded flange, its companion flange, nozzle, or coupling. Such product discharge valves (outflow) shall, in addition to normal means, be closed by (1) an automatic heat actuated means which will become effective at a temperature not over 250° F., (2) a secondary closing means, remote from tank filling or discharge openings, for operation in event of fire or other accident.

[Order 73, 32 FR 3464, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.341-6 Gauging devices.

(a) No applicable provisions.

[Order 73, 32 FR 3464, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.341-7 Method of test.

(a) *Test for leaks.* Every cargo tank shall be tested by a minimum air or hydrostatic pressure of 3 p.s.i.g. or at least equal to the tank design pressure of § 178.341-1(b) whichever is greater applied to the whole tank and dome if it be noncompartmented. If compartmented each individual compartment shall be similarly tested with adjacent compartments empty and at atmospheric pressure. Air pressure, if used, shall be held for a period of at least 5 minutes during which the entire surface of all joints under pressure shall be coated with a solution of soap and water, heavy oil, or other material suitable for the purpose, foaming or bubbling of which indicates the presence of leaks. Hydrostatic pressure, if used, shall be done by using water or other liquid having a similar viscosity, the temperature of which shall not exceed 100° F. during the test, and applying pressure as prescribed above, gauged at the top of the tank, at which time all joints under pressure shall be inspected for the issuance of liquid to indicate leaks. All closures shall be in place while test by either method is made. During these tests, operative relief devices shall be clamped, plugged, or otherwise rendered inoperative; such clamps, plugs, and similar devices shall be removed immediately after the test is finished. Any leakage discovered by either of the methods above described, or by any other method, shall be deemed evidence of failure to meet the requirements of this specification. Tanks failing to pass this test shall be suitably repaired, and the above described tests shall be continued until no leaks are discovered, before any cargo tank is put into service.

(b) *Test for distortion or failure.* Every cargo tank shall be tested by pressures prescribed in paragraph (a) of this section and shall withstand such pressure without undue distortion, evidence of impending failure, or failure. Failure to meet this requirement shall be deemed as sufficient cause for rejection under this specification. If there is undue distortion, or if failure impends or occurs, the cargo tank shall not be placed in or returned to service unless an adequate repair is made. The adequacy of the repair shall be determined by the same method of test.

[Order 73, 32 FR 3464, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.342 Specification MC 307; cargo tanks.

[Order 73, 32 FR 3464, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.342-1 General requirements.

(a) Specification MC 307 cargo tanks must comply with the general design and construction requirements in § 178.340, in addition to the specific design requirements contained in this section.

(b) The design pressure (maximum allowable working pressure) of each cargo tank shall be not less than 25 p.s.i.g. For working pressures in excess of 50 p.s.i.g. the tank must be designed in accordance with the requirements of the ASME Code.

(c) Tanks shall be of circular cross-section.

[Order 73, 32 FR 3464, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18251, Nov. 14, 1969]

§ 178.342-2 Thickness of shell, heads, bulkheads, and baffles.

(a) *Material thickness.* The minimum thicknesses of tank material authorized in § 178.340-3 shall be not less than those obtained by applying the following formulas nor less than those specified in Tables I and II below:

$$\text{Thickness of shell} = T_s = PD/2SE_s$$

$$\text{Thickness of heads} = T_h = 0.885PL^*/SE_h$$

*For pressure on concave side only.

where:

T_s = Minimum thickness of shell material, exclusive of allowance for corrosion or other loadings.

T_h = Minimum thickness of head material, after forming, exclusive of allowance for corrosion and other loadings.

P = Design pressure, pounds per square inch.

D = Inside diameter of shell, inches.

L = Inside crown radius of head, inches.

S = Maximum allowable stress value, pounds per square inch—equals one-fourth of specified minimum ultimate tensile strength (one-fourth of aluminum alloy's annealed minimum ultimate strength).

E_s = Lowest efficiency of any longitudinal joint in shell (85 percent maximum).

E_h = Lowest efficiency of any joint in head (85 percent maximum).

TABLE I—MINIMUM THICKNESS OF HEADS, BULKHEADS, AND BAFFLES. MILD STEEL (MS), HIGH STRENGTH LOW ALLOY (HSLA), AND AUSTENITIC STAINLESS STEEL (SS) EXPRESSED IN U.S. GAUGE; ALUMINUM ALLOY (AL) IN DECIMALS OF AN INCH

	Volume capacity of tank in gallons per inch						
	10 or less	Over 10 to 14	14 to 18	18 to 22	22 to 26	26 to 30	30 and over
	Thickness						
MS	14	13	12	11	10	9	8
HSLA, SS	15	14	13	12	11	10	9
AL	0.109	0.130	0.151	0.173	0.194	0.216	0.237

TABLE II—MINIMUM THICKNESS OF SHELL SHEETS. MILD STEEL (MS), HIGH STRENGTH LOW ALLOY (HSLA), AND AUSTENITIC STAINLESS STEEL (SS) EXPRESSED IN U.S. STANDARD GAUGE; ALUMINUM ALLOY (AL) IN DECIMALS OF AN INCH

Distance between bulkheads, baffles, or other shell stiffeners	Volume capacity of tank in gallons per inch						
	10 or less	Over 10 to 14	14 to 18	18 to 22	22 to 26	26 to 30	30 and over
36 inches or less:							
MS	14	14	14	13	12	11	10
HSLA, SS	16	16	15	14	13	12	11
AL	0.109	0.109	0.109	0.130	0.151	0.173	0.194
Over 36 to 54 inches:							
MS	14	14	13	12	11	10	9
HSLA, SS	16	15	14	13	12	11	10
AL	0.109	0.109	0.130	0.151	0.173	0.194	0.216
54 through 60 inches:							
MS	14	13	12	11	10	9	8
HSLA, SS	15	14	13	12	11	10	9
AL	0.109	0.130	0.151	0.173	0.194	0.216	0.237

(1) The knuckle radius of the head shall not be less than three times the material thickness. The straight flange shall not be less than three times the material thickness for butt-welded heads.

(2) For heads with pressure on the convex side, the material thickness as obtained by the above formula shall be increased by 67 percent unless such heads are adequately braced to prevent excessive distortion.

(b) *Corrosion allowance.* Vessels or part of vessels subject to thinning by corrosion, erosion, or mechanical abrasion, shall have provision made to withstand the intended life and service by a suitable increase in the thickness of the material over that determined by the design formulas, or by using some other suitable method of protection. Material added for these purposes need not be of the same thickness for all parts of the vessel if different rates of attack are expected for the various parts.

[Order 73, 32 FR 3464, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.342-3 Closures for manholes.

(a) Each compartment shall be accessible through a 15-inch minimum inside diameter manhole. The manhole cover shall be designed to provide a secure closure of the manhole. All joints between manhole covers and their seats shall be made tight against leakage of vapor and liquid. Gaskets, if used, shall be of suitable material not subject to attack by lading.

(1) Closures shall have structural capability of withstanding internal fluid pressures of 40 p.s.i.g. or 1.5 times the design pressure of the tank whichever is greater without permanent deformation. Safety devices to prevent the manhole and/or fill cover from opening fully when internal pressure is present shall be provided.

[Order 73, 32 FR 3464, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.342-4 Vents.

(a) Each cargo tank compartment shall be provided with safety relief devices in accordance with the requirements contained in this paragraph. All of such devices shall communicate with the vapor space. Shutoff valves shall not be installed between the tank opening and any safety device. Safety relief devices shall be so mounted, shielded, or drained as to eliminate the accumulation of water, the freezing of which could impair the operation or discharge capability of the device.

(b) *Total capacity:* Every cargo tank compartment shall be provided with one or more devices with sufficient capacity to limit the tank internal pressure to a maximum of 130 percent of the tank design pressure. This total venting capacity shall be not less than that determined from Table III, using the external surface of the cargo tank or tank compartment as the exposed area.

(c) *Pressure-actuated venting (spring loaded):* Every cargo tank compartment shall be equipped with pressure-actuated vent or vents set to open at not less than the tank design pressure. The minimum venting capacity for pressure actuated vents shall be 12,000 cubic feet of free air per hour (14.7 p.s.i.a. and 60° F.) per compartment or 12,000 cubic feet of free air per hour (14.7 p.s.i.a. and 60° F.) for each 350 square feet of exposed tank area, whichever is greater. This minimum capacity shall be measured at a pressure of 130 percent of the tank design pressure. Pressure actuated devices shall be designed to function in case of pressure rise when in any condition of roll over attitude. If pressure (maximum limits to be included on the metal certification plate § 178.340-10(b)) unloading devices are provided, the relief valve shall have sufficient capacity to limit the tank internal pressure to 130 percent of design pressure.

(d) *Fusible and frangible venting:* If the pressure-actuated venting required by paragraph (c) of this section does not provide the total venting capacity required by paragraph (b) of this section, additional capacity shall be provided by adding fusible and/or frangible venting devices. Each fusible device shall have a minimum area of 1.25 square inches and shall be actuated by elements which operate at a temperature not exceeding 250° F. when the tank pressure is between the tank design pressure and 130 percent of the tank design pressure. Such fusible elements shall be so located as to not be in contact with the lading under normal operating conditions. The bursting pressure of frangible devices shall be not less than 130 percent nor more than 150 percent of the tank design pressure.

TABLE III—MINIMUM EMERGENCY VENT CAPACITY IN CUBIC FEET; FREE AIR/HOUR (14.7 P.S.I.A. AND 60° F.)

Exposed area square feet	Cubic feet free air per hour
20	15,800
30	23,700
40	31,600
50	39,500
60	47,400
70	55,300
80	63,300
90	71,200
100	79,100
120	94,900
140	110,700
160	126,500
180	142,300
200	158,100
225	191,300
250	203,100
275	214,300
300	225,100
350	245,700
400	265,000
450	283,200
500	300,600
550	317,300
600	333,300
650	348,800
700	363,700
750	378,200
800	392,200
850	405,900
900	419,300
950	432,300
1,000	445,000

NOTE 1: Interpolate for intermediate sizes.

(e) *Flow testing and marking of vents:* Each type and size of venting devices shall be flow tested in the ranges specified in the applicable preceding paragraphs. The actual rated flow capacity of the vent in cubic feet of free air per hour at the pressure in p.s.i.g. at which the flow capacity is determined shall be stamped on the device.

(1) These flow tests may be conducted by the manufacturer or may be delegated to a certified agency.

[Order 73, 32 FR 3465, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-25, 36 FR 18469, Sept. 15, 1971]

§ 178.342-5 Outlets.

(a) Each product discharge opening shall be equipped with a self-closing shut-off valve, designed, installed, and protected in accordance with § 178.340-8(d) and operated so as to assure against the accidental escape of contents. These valves shall be located inside the tank or within the welded flange, its companion flange, nozzle, or coupling. Such product discharge valves (outflow) shall, in addition to normal means, be closed by (1) an automatic heat actuated means which will become effective at a temperature not over 250° F., (2) a secondary closing means, remote from tank filling or discharge openings, for operation in event of fire or other accident.

(b) Vapor return lines, if used, may be equipped with an excess flow valve at the tank connection if a positive shutoff valve is provided between the excess-flow valve and the hose connection.

[Order 73, 32 FR 3465, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.342-6 Gauging devices.

(a) *Gauge device design.* Every tank compartment except tanks filled by weight, shall be equipped with one or more gauging devices which shall indicate accurately the maximum permitted liquid level in each compartment. Additional gauging devices may be installed but may not be used as primary controls for filling of cargo tanks at pressures above atmospheric. Acceptable gauging devices for use at pressures above atmospheric are the rotary tube, the adjustable slip tube and the fixed length dip tube. Gauge glasses are not permitted to be installed on any cargo tank.

(b) *Fixed level indicators.* All liquid level gauging devices, except those on tanks provided with fixed maximum level indicators, shall be legibly and permanently marked in increments of not more than 20° F. to indicate the maximum levels to which the tank may be filled with liquid at temperatures above 20° F. In the event that it is impracticable to put these markings on the gauging device, this information shall be marked on a suitable plate affixed to the tank in a location adjacent to the gauging device.

(c) *Dip tubes.* A fixed length dip tube gauging device when used shall consist of a dip pipe of small diameter equipped with a valve at the outer end, and extending into the tank to a specified fixed length. On horizontally mounted cylindrical tanks, the fixed length to which the tube extends into the tank shall be such that the device will function to indicate when the liquid reaches the maximum level permitted by the regulations in this part.

[Order 73, 32 FR 3465, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.342-7 Method of test.

(a) *Test pressure.* The standard test pressure for each required test shall be 40 p.s.i.g. or a minimum of 1.5 times design pressure whichever is greater.

(b) *Method of test.* Every cargo tank shall be tested by complete filling (including domes if any) with water or other liquid having a similar viscosity and applying a pressure of not less than the standard test pressure specified in paragraph (a) of this section. The pressure shall be gauged at the top of the tank. The tank shall hold the prescribed pressure for at least 10 minutes. All tank accessories shall be leakage tested after installation and proved tight at not less than the design pressure of the tank, except that hose used on such tanks may be tested either before or after installation. Failure to successfully meet the test criteria shall be deemed evidence of failure to meet the requirements of this specification. Tanks failing to pass this test shall be suitably repaired. The suitability of the repair shall be determined by the same method of test.

(1) *When divided into compartments.* When the interior of the tank is divided into compartments, each compartment shall be tested as a separate tank with adjacent compartments empty and at atmospheric pressure.

[Order 73, 32 FR 3465, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.343 Specification MC 312; cargo tanks.

[Order 73, 32 FR 3465, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.343-1 General requirements.

(a) Specification MC 312 cargo tanks must comply with the general design and construction requirements in § 178.340 in addition to the specific requirements contained in this section.

(b) *Tank design:* Cargo tanks built under this specification that are unloaded by pressure in excess of 15 p.s.i.g. must be designed and constructed in accordance with and fulfill all requirements of the ASME Code. No tank shall have head, bulkhead, and baffle or shell thicknesses less than that specified in § 178.343-2, Tables I and II, nor shall the spacing of bulkheads, baffles, or shell stiffeners exceed that specified in § 178.340-7.

(c) Design pressure shall be not less than pressure used for unloading.

[Order 73, 32 FR 3465, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-7, 34 FR 18251, Nov. 14, 1969]

§ 178.343-2 Thickness of shell, heads, bulkheads, and baffles of non-ASME Code tanks.

(a) *Material thickness.* The minimum thicknesses of tank material authorized in § 178.340-3 shall be predicated on not exceeding the maximum allowable stress level in § 178.340-4(a) but in no case less than those indicated in Tables I and II listed below, or the accompanying aluminum alloy formula:

TABLE I—MINIMUM THICKNESS OF HEADS, BULKHEADS, AND BAFFLES. MILD STEEL (MS), HIGH STRENGTH LOW ALLOY STEEL (HSLA), AUSTENITIC STAINLESS STEEL (SS), IN U.S. STANDARD GAUGE—UNLESS OTHERWISE EXPRESSED IN FRACTIONS OF AN INCH

	Volume capacity in gallons per inch											
	10 or less			Over 10 to 14			14 to 18			18 and over		
	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.
	Product weight in pounds per gallon at 60° F											
Thickness	12	10	8	10	8	3/16	9	3/16	¼	8	¼	¼

TABLE II—MINIMUM THICKNESS OF SHELL SHEETS, MILD STEEL (MS), HIGH STRENGTH LOW ALLOY STEEL (HSLA), AUSTENITIC STAINLESS STEEL (SS) IN U.S. STANDARD GAUGE—UNLESS OTHERWISE EXPRESSED IN FRACTIONS OF AN INCH

Distances between bulkheads, baffles, or ring stiffeners	Volume capacity in gallons per inch											
	10 or less			Over 10 to 14			14 to 18			18 and over		
	Product weight in pounds per gallon at 60° F											
	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.
MAXIMUM SHELL RADIUS												
LESS THAN 70 INCHES												
36 inches or less	12	10	8	12	10	8	12	10	8	10	8	3/16
Over 36 inches to 54 inches	12	10	8	12	10	8	10	8	3/16	9	3/16	¼
54 inches through 60 inches	12	10	8	10	8	3/16	9	3/16	¼	8	¼	¼
70 INCHES OR MORE, LESS THAN 90 INCHES												
36 inches or less	12	10	8	12	10	8	10	8	3/16	9	3/16	¼
Over 36 inches to 54 inches	12	10	8	10	8	3/16	9	3/16	¼	8	¼	¼
54 inches through 60 inches	10	8	3/16	9	3/16	¼	8	¼	¼	3/16	¼	3/16
90 INCHES OR MORE, LESS THAN 125 INCHES												
36 inches or less	12	10	8	10	8	3/16	9	3/16	¼	8	¼	¼
Over 36 inches to 54 inches	10	8	3/16	9	3/16	¼	8	¼	¼	3/16	¼	5/16

TABLE II—MINIMUM THICKNESS OF SHELL SHEETS, MILD STEEL (MS), HIGH STRENGTH LOW ALLOY STEEL (HSLA), AUSTENITIC STAINLESS STEEL (SS) IN U.S. STANDARD GAUGE—UNLESS OTHERWISE EXPRESSED IN FRACTIONS OF AN INCH—Continued

Distances between bulkheads, baffles, or ring stiffeners	Volume capacity in gallons per inch											
	10 or less			Over 10 to 14			14 to 18			18 and over		
	Product weight in pounds per gallon at 60 F											
	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.	10 lbs. and less	Over 10 to 13 lbs.	13 to 16 lbs.
54 inches through 60 inches	9	3/16	1/4	8	1/4	1/4	3/16	1/4	5/16	3/16	1/4	5/16
125 INCHES OR MORE												
36 inches or less	10	8	3/16	9	3/16	1/4	8	1/4	1/4	3/16	1/4	5/16
Over 36 inches to 54 inches	9	3/16	1/4	8	1/4	1/4	3/16	1/4	5/16	3/16	1/4	5/16
54 inches through 60 inches	8	1/4	1/4	3/16	1/4	3/16	3/16	1/4	5/16	1/4	5/16	3/8

(1) *Aluminum alloy formula.*

Thickness of aluminum alloy materials = Steel thickness from Tables I and II × $(3 \times 10^7/E)^{1/3}$

where:

E = Modulus of elasticity of the material to be used.

(b) *Lining.* Except as provided in paragraph (c) of this section, cargo tanks shall be lined and the material used for lining each cargo tank subject to this specification shall be homogenous, nonporous, imperforate when applied, not less elastic than the metal of the tank proper, and substantially immune to attack by the commodities to be transported therein. It shall be directly bonded or attached by other equally satisfactory means. Joints and seams in the lining shall be made by fusing the material together, or by other equally satisfactory means.

(c) *Conditions under which tanks need not be lined.* Tanks need not be lined as provided in paragraph (b) of this section, if:

(1) The material of the tank is substantially immune to attack by the materials to be transported therein; or,

(2) The material of the tank is thick enough to withstand 10 years normal service without being reduced at any point to less thickness than that specified in paragraph (a) of this section corresponding to its type; or,

(3) The chemical reaction between the material of the tank and the commodity to be transported therein is such as to allow the tank to be properly passivated or neutralized and if the tank is not frequently cleaned and not used in the transportation of other commodities.

[Order 73, 32 FR 3466, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.343-3 Closure for manholes.

(a) Each compartment shall be accessible through a manhole conforming to paragraph UG-46(g)(1) of the ASME Code. The manhole cover shall be designed to provide a secure closure of the manhole. All joints between manhole covers and their seats shall be tight against leakage of vapor and liquid. Gaskets, if used, shall be of suitable material not subject to attack by lading.

(1) The manhole cover shall have structural capability of withstanding internal fluid pressures equal to 1.5 times the design pressure of the tank and in no case less than 15 p.s.i.g. without permanent deformation. Safety devices to prevent the manhole and/or fill cover from opening fully when internal pressure is present shall be provided.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53, App. A to Part 1, and paragraph (a)(4) App. A to Part 106)

[Order 73, 32 FR 3466, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 178-61, 45 FR 46423, July 10, 1980]

§ 178.343-4 Vents.

(a) *Safety vent.* Every cargo tank compartment shall be equipped with suitable pressure relief devices as required by the ASME Code, or shall be fitted with suitable rupture discs in lieu of mechanical pressure relief valves. Such discs shall be designed to rupture at not to exceed 1.5 times the design pressure of the tank. If air inlet devices are provided a relief valve shall have adequate capacity to limit tank pressure to 130 percent of design pressure at maximum inlet flow rate. Such maximum limits to be included on the metal certification plate § 178.340-10(b). Air inlet lines if permanently connected to an air source shall be equipped with a check valve. Shutoff valves between the tank and relief valve or rupture disc are prohibited.

[Order 73, 32 FR 3466, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.343-5 Outlets.

(a) Each outlet at or near the top of a tank, used for discharge of lading, must be equipped with a shutoff valve located as close as practical to the point of outlet from the tank. Each such outlet having its discharge end below the top liquid level in the tank must be equipped with an additional shutoff valve, blank flange, or sealing cap at the discharge end of the outlet.

(b) Except as provided in paragraphs (c) and (d), of this section; each bottom outlet must be equipped with a shutoff valve designed, installed, and protected as follows:

(1) Product piping must be protected in such a manner as to reasonably assure against the accidental escape of contents. Such protection must be provided by:

(i) A shear section located out-board of each valve seat and within 4 inches of the vessel which will break under strain and leave the valve seat and its attachment to the vessel and the valve head intact and capable of retaining product. The shear section shall be machined in such a manner as to abruptly reduce the wall thickness of the adjacent piping (or valve) material by at least 20 percent; or

(ii) By suitable guards capable of absorbing a concentrated horizontal force of at least 8,000 pounds applied from any horizontal direction, without damage to the discharge piping which will adversely affect the product retention integrity of the discharge valve.

(2) Each bottom outlet valve must be located inside the tank or immediately adjacent at the outlet point outside the tank.

(i) The valve seat must be located inside the tank or within the welded flange, its companion flange, nozzle, or coupling at the point of outlet from the tank.

(ii) Each bottom discharge valve must be equipped with a remote means to activate a valve closure manually from a point no less than 10 feet away.

(3) In addition, a blank flange, sealing cap, or shutoff valve is required at the discharge end of the outlet.

(c) A bottom opening for purposes other than lading discharge may be closed by a bolted blank flange at the tank shell. If any piping extends from such an opening, it must be fitted with a shutoff valve designed, installed, and protected as described in paragraph (b)(1) of this section. In addition a supplemental closure is required at the discharge end of this piping.

(d) Bottom outlet valves need not meet paragraph (b)(2)(ii) of this section when the cargo tank is transporting a corrosive liquid containing solids in suspension in sufficient quantity that settling may form a layer of solid material that may interfere with sealing of the valve seat.

(18 U.S.C. 834; 49 CFR 1.53(g))

[Amdt. 178-26, 38 FR 20840, Aug. 3, 1973; Amdt. 178-29, 38 FR 35471, Dec. 28, 1973, as amended by Amdt. 178-38, 41 FR 3869, Jan. 27, 1976]

§ 178.343-6 Gauging devices.

(a) No applicable requirement.

[Order 73, 32 FR 3467, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

§ 178.343-7 Method of test.

(a) *Test for leaks.* Every cargo tank shall be tested by completely filling the tank and dome with water or other liquid having a similar viscosity, the temperature of which shall not exceed 100° F. during the test, and applying a pressure of 1.5 times the design pressure but not less than 3 p.s.i.g. The pressure shall be gauged at the top of the tank. The tank shall hold the prescribed pressure for at least 10 minutes without failure, undue distortion, leakage or evidence of impending failure. All closures shall be in place while test is made. During these tests, operative relief devices shall be clamped, plugged or otherwise rendered inoperative; such clamps, plugs, and similar devices shall be removed immediately after the test is finished.

(b) *Test for distortion or failure.* Every cargo tank shall be tested by the pressures prescribed in paragraph (a) of this section and shall withstand such pressures without undue distortion or other indication of impending failure. If there is undue distortion, or if failure impends or occurs, the cargo tank shall not be placed in or returned to service unless an adequate repair is made. The adequacy of the repair shall be determined by the same method of test.

(c) *Test of heating system.* After an interior heating system consisting of coil piping is installed, and before the tanks to which they are fitted are placed in service, the heating system shall be tested. Systems employing media such as steam or hot water under pressure for heating the contents of cargo tanks shall be tested with hydrostatic pressure and proved to be tight at 200 p.s.i.g.

(d) *When divided into compartments.* When the interior of the tank is divided into compartments, each compartment shall be tested as a separate tank.

[Order 73, 32 FR 3467, Mar. 2, 1967. Redesignated at 32 FR 5606, Apr. 5, 1967]

Subpart K—Specifications for General Packagings

§ 178.350 Specification 7A; general packaging, Type A.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968]

§ 178.350-1 General requirements.

(a) Each packaging must meet all applicable requirements of § 173.24 of this chapter.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968]

§ 178.350-2 Specific requirements.

(a) Each packaging must be so designed and constructed that it meets the standards for Type A packaging (see §§ 173.389(j) and 173.398(b) of this chapter).

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968]

§ 178.350-3 Marking.

(a) Marking on the outside of each packaging as follows: "USA DOT 7A Type A" and "Radioactive Material."

(b) The letter and number size and additional marking requirements of § 173.24 of this subchapter must be complied with.

[Amdt. 178-1, 33 FR 14935, Oct. 4, 1968, as amended by Amdt. 178-40, 41 FR 38183, Sept. 9, 1976]

APPENDICES TO PART 178

APPENDIX A—SPECIFICATIONS FOR STEEL

TABLE 1

[Open-hearth, basic oxygen, or electric steel of uniform quality. The following chemical composition limits are based on ladle analysis:]

Designation	Chemical composition, percent-ladle analysis		
	Grade 1[1]	Grade 2[1 2]	Grade 3[2 4 5]
Carbon	0.10/0.20	0.24 maximum	0.22 maximum.
Manganese	1.10/1.60	0.50/1.00	1.25 maximum.
Phosphorus, maximum	0.04	0.04	0.045.[6]
Sulfur, maximum	0.05	0.05	0.05.
Silicon	0.15/0.30	0.30 maximum	
Copper, maximum	0.40		

TABLE 1—Continued

[Open-hearth, basic oxygen, or electric steel of uniform quality. The following chemical composition limits are based on ladle analysis:]

Designation	Chemical composition, percent-ladle analysis		
	Grade 1[1]	Grade 2[1 2]	Grade 3[2 4 5]
Columbium		0.01/0.04	
Heat treatment authorized	(3)	(3)	(3)
Maximum stress (p.s.i.)	35,000	35,000	35,000.

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[1] Addition of other elements to obtain alloying effect is not authorized.

[2] Ferritic grain size 6 or finer according to ASTM E112-63.

[3] Any suitable heat treatment in excess of 1,100° F., except that liquid quenching is not permitted.

[4] Other alloying elements may be added and shall be reported.

[5] For compositions with a maximum carbon content of 0.15 percent of ladle analysis, the maximum limit for manganese on ladle analysis may be 1.40 percent.

[6] Rephosphorized Grade 3 steels containing no more than 0.15 percent phosphorus are permitted if carbon content does not exceed 0.15 percent and manganese does not exceed 1 percent.

CHECK ANALYSIS TOLERANCES

[A heat of steel made under any of the above grades, the ladle analysis of which is slightly out of the specified range is acceptable if the check analysis is within the following variations:]

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Carbon	To 0.15 inclusive	0.02	0.03
	Over 0.15 to 0.40 inclusive	0.03	0.04
Manganese	To 0.60 inclusive	0.03	0.03
	Over 0.60 to 1.15 inclusive	0.04	0.04
	Over 1.15 to 2.50 inclusive	0.05	0.05
Phosphorus[7]	All ranges		0.01
Sulfur	All ranges		0.01
Silicon	To 0.30 inclusive	0.02	0.03
	Over 0.30 to 1.00 inclusive	0.05	0.05
Copper	To 1.00 inclusive	0.03	0.03
	Over 1.00 to 2.00 inclusive	0.05	0.05
Nickel	To 1.00 inclusive	0.03	0.03
	Over 1.00 to 2.00 inclusive	0.05	0.05
Chromium	To 0.90 inclusive	0.03	0.03
	Over 0.90 to 2.10 inclusive	0.05	0.05
Molybdenum	To 0.20 inclusive	0.01	0.01
	Over 0.20 to 0.40 inclusive	0.02	0.02
Zirconium	All ranges	0.01	0.05
Columbium	To 0.04 inclusive	0.005	0.01
Aluminum	Over 0.10 to 0.20 inclusive	0.04	0.04
	Over 0.20 to 0.30 inclusive	0.05	0.05

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[7] Rephosphorized steels not subject to check analysis for phosphorus.

(49 U.S.C. 1804, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 178-3, 34 FR 12283, July 25, 1969; 34 FR 12593, Aug. 1, 1969, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980]

APPENDIX B—SPECIFICATIONS FOR PLASTICS

TABLE I

[Polyethylene must have the following properties, as determined by the American Society For Testing Materials (ASTM) methods designated. Tests must be performed on resin with additives included:]

Property	Type I	Type II	Type III	ASTM method
Density, g./cc	0.910 – 0.926	0.926 – 0.941	0.941 – 0.965	D 1505-68.
Melt index (flow rate)	2.0 max	1.0 max	1.0 max	D 1238-65T.

TABLE I—Continued

[Polyethylene must have the following properties, as determined by the American Society For Testing Materials (ASTM) methods designated. Tests must be performed on resin with additives included:]

Property	Type I	Type II	Type III	ASTM method
Tensile strength	1,500 p.s.i min	1,800 p.s.i	3,000 p.s.i	D 638-68.
Elongation	400% min	400%	75%	D 638-68.

Other materials may be added to polyethylene resin provided they do not adversely affect the physical properties specified above.

[Amdt. 178-5, 34 FR 12593, Aug. 1, 1969; Amdt. 178-32, 39 FR 12752, Apr. 8, 1974]

PART 179—SPECIFICATIONS FOR TANK CARS

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179.300 General specifications applicable to multi-unit tank car tanks designed to be removed from car structure for filling and emptying (Classes DOT-106A and 110AW).
179.301 Individual specification requirements for multi-unit tank car tanks.
179.302 Special commodity requirements for multi-unit tank car tanks.

Subpart F—Specifications for Liquefied Hydrogen Tank Car Tanks and Seamless Steel Tanks (Classes DOT-113A-W and 107A)

179.400 General specifications applicable to liquefied hydrogen tank car tanks.
179.401 Individual specification requirements for liquefied hydrogen tank car tanks.
179.500 Specification DOT-107A * * * *, seamless steel tank car tanks.

AUTHORITY: 49 U.S.C. 1804, 1808; 49 CFR 1.53(e), unless otherwise noted.

SOURCE: 29 FR 18995, Dec. 29, 1964, unless otherwise noted. Redesignated at 32 FR 5606, Apr. 5, 1967.

EDITORIAL NOTE: The technical amendment appearing at 35 FR 13835, Sept. 1, 1970, deleted the separating hyphens from references to specification identifications of tank cars.

Subpart A—Introduction, Approvals and Reports

§ 179.1 General.

(a) This part prescribes the specifications for tanks that are to be mounted on or form part of a tank car and which are used for the transportation of hazardous materials in commerce.

(b) Except as provided in paragraph (c) of this section, tanks to which this part is applicable, must be built to the specifications prescribed in this part.

(c) Tanks built to specifications predating those in this part may continue in use as provided in § 173.31 of this subchapter.

(d) Any person who performs a function prescribed in this part, shall perform that function in accordance with this part.

(e) When this part requires a tank to be marked with a DOT specification (for example, DOT-105A100W), compliance with that requirement is the responsibility of the tank builder. Marking the tank with the DOT specification shall be understood to certify compliance by the builder that the functions performed by the builder, as prescribed in this part, have been performed in compliance with this part.

(f) The tank builder should inform each person to whom that tank is transferred of any specification requirements which have not been met at time of transfer.

[Amdt. 179-17, 41 FR 38183, Sept. 9, 1976]

§ 179.2 Definitions and abbreviations.

(a) The following apply in Part 179:

(1) "AAR" means Association of American Railroads.

(2) "Approved" means approval by the AAR Committee on Tank Cars.

(3) "ASTM" means American Society for Testing and Materials.

(4) "DOT" and "Department" means Department of Transportation.

(5) Definitions in Part 173 of this chapter also apply.

(6) "F" means degrees Fahrenheit.

(7) "NGT" means National Gas Taper Threads.

(8) "NPT" means American Standard Tape Pipe Thread.

(9) "Psi" means pounds per square inch gauge.

(10) "Tanks" means tank car tanks.

[29 FR 18995, Dec. 20, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21344, Nov. 6, 1971]

§ 179.3 Procedure for securing approval.

(a) Application for approval of designs, materials and construction, conversion or alteration of tank car tanks under these specifications, complete with detailed prints, shall be submitted in prescribed form to the Secretary, Mechanical Division, AAR, for consideration by its Committee on Tank Cars and other appropriate committees. Approvals or rejections of applications, based on appropriate committee action, shall be issued by said Secretary.

(b) When, in the opinion of the Committee, such tanks or equipment therefor are in compliance with effective regulations and specifications of the Department, the application will be approved.

(c) When, in the opinion of the Committee, such tanks or equipment therefor are not in compliance with effective regulations and specifications of the Department, the Committee may recommend service trials to determine the merits of a change in specifications. Such service trials may be authorized by the Department under the terms of "DOT Special Permits."

§ 179.4 Changes in specifications for tank cars.

(a) Proposed changes in or additions to specifications for tanks shall be submitted to the Secretary, Mechanical Division, AAR, for consideration by its Committee on Tank Cars. An application for construction of tanks to any new specification may be submitted with proposed specification. Construction should not be started until the specification has been approved or special permit has been issued. When proposing a new specification, the applicant shall furnish information to justify a new specification. This data should include the properties of the lading and the method of loading and unloading.

(b) The Subcommittee on Specifications of the Committee on Tank Cars shall review the proposed specification at its earliest convenience and report its recommendations to the Committee on Tank Cars for prompt consideration. The Committee on Tank Cars shall report its recommendations through said Secretary to the Department; such reports may be submitted to the Bureau of Explosives for its recommendation before action by the Department. Expert opinion thus obtained will be given due consideration by the Department in determining appropriate action.

§ 179.5 Certificate of construction.

(a) Except as provided in paragraph (b) of this section, before a tank car is placed in service, the party assembling the completed car shall furnish a Certificate of Construction, Form AAR 4-2 to the owner, the Bureau of Explosives (as required by § 179.5(d)), and the Secretary, Mechanical Division, AAR, certifying that the tank, equipment, and car completed comply with all the requirements of the specification.

(b) Before a tank of Class DOT-106A, 107A, or 110A is placed in service, the builder must furnish a Certificate of Construction, Form AAR 4-2 to the owner, the Bureau of Explosives (as required by paragraph (d) of this section), and the Secretary, Mechanical Division, AAR, in addition to a Certificate of Inspector's Report as required in § 179.300-20 and § 179.500-18 in prescribed form certifying that the tank and appurtenances comply with all the requirements of the specifications.

(c) If the owner elects to furnish the appurtenances such as valves and safety devices, the owner shall furnish to the Bureau of Explosives, and to the Secretary, Mechanical Division, AAR, a report in prescribed form, certifying that the appurtenances comply with all the requirements of the specifications.

(d) When cars or tanks which are covered on one application and are identical in all details are built in series, one certificate shall suffice for each series when submitted to the Secretary. One copy of the Certificate of Construction must be furnished to the Bureau of Explosives for each car number of consecutively numbered group or groups covered by the original application.

[Amdt. 179-10, 36 FR 21344, Nov. 6, 1971]

§ 179.6 Repairs and alterations.

For procedure to be followed in making repairs or alterations, see Appendix R of the AAR Specifications for Tank Cars.

[Amdt. 179-10, 36 FR 21344, Nov. 6, 1971]

Subpart B—General Design Requirements

§ 179.10 Tank mounting.

(a) The manner in which tanks are attached to the car structure shall be approved. The use of rivets to secure anchors to tanks prohibited.

§ 179.11 Welding certification.

(a) Welding procedures, welders and fabricators shall be approved.

§ 179.12 Interior heater systems.

§ 179.12-1 General.

(a) Interior heater systems shall be of approved design and materials. If a tank is divided into compartments, a separate system shall be provided for each compartment.

§ 179.12-2 Materials and dimensions.

(a) Interior heater systems and plug flanges, if welded to tank or dome, shall be cast, forged or fabricated metal, and be of good weldable quality in conjunction with metal of tank or dome.

(b) Piping must be not less than 2 inches IPS. Tubing must be not less than 2⅜ inches outside diameter and the wall thickness must be at least equivalent to the corresponding pipe size. Material specifications and nominal wall thickness must be as follows:

Material	Nominal thickness minimum[1]		Specifications ASTM
	2 inches	Over 2 inches	
Carbon steel	0.175	Schedule 40	A53-69a, A192-69, A178-70.
Alloy steel	Schedule 40S	Schedule 40S	A312-70, A269-69.
Aluminum	Schedule 80	Schedule 80	B241-69, B210-70, B221-69.
Nickel	Schedule 40	Schedule 40	B161.70.

[1] Thickness must be increased 25 percent or to next higher schedule, whichever is less, when threaded joints are used.

(c) Systems may be fabricated of other materials and of other than circular cross section, if approved.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21344, Nov. 6, 1971]

§ 179.12-3 Joints and fittings.

(a) Welded butt joints are preferable. Bolted joints with flange welded to piping may be used if welding is not feasible or to facilitate tank cleaning or application of linings. Return bends shall be forged, or made by bending the pipe. Cast, forged or fabricated manifolds of approved design may be used.

(b) Inlets and outlets of heater systems shall be equipped with valve cock, cap or plug. Caps and plugs shall be secured by chain.

§ 179.12-4 Application to tank.

(a) Interior heater systems shall be so constructed that the breaking off of their external connections will not cause leakage of contents of tank.

(b) Inlets and outlets may be located in any portion of dome, shell, heads, or steam jacketed outlet provided proper drainage of heater system is accomplished.

(c) If ends of coils are not attached to a manifold or steam jacketed outlet, they shall be attached to pads or reinforcements. Such reinforcements must be attached to tank in compliance with the requirements of the tank specification.

(1) Outside pipe connections to steam coils shall not be an integral part of the interior coils and shall be screwed or welded, or both, into outside of pads or reinforcements.

(d) All piping shall be secured so as to permit necessary expansion and contraction.

§ 179.12-5 Tests.

(a) Each interior heater system shall be hydrostatically tested at not less than 200 psi and shall hold the pressure for 10 minutes without leakage or evidence of distress.

§ 179.12-6 Reports.

(a) The Certificate of Construction for the completed car shall indicate installation of interior heater system and date of initial hydrostatic test.

§ 179.12-7 Stenciling.

(a) To indicate that tank is equipped with interior heater system, the tank, or the jacket if tank is insulated, shall be stenciled in compliance with the applicable requirements of AAR Specifications for Tank Cars, Appendix C.

§ 179.13 Tank car capacity and gross weight limitation.

Tank cars built after November 30, 1970, must not exceed 34,500 gallons capacity or 263,000 pounds gross weight on rail. Existing tank cars may not be converted to exceed 34,500 gallons capacity or 263,000 pounds gross weight on rail.

[Amdt. 179-4, 35 FR 14217, Sept. 9, 1970]

§ 179.14 Tank car couplers.

(a) All tank cars built after January 1, 1971, must be equipped with interlocking automatic couplers that will resist car telescoping and jackknifing in derailments and in emergency stops, and that have been approved by the Federal Railroad Administrator.

(1) Effective November 9, 1977, couplers designated by the Association of American Railroads Catalog Nos. SE60CHT, SE60CHTE, SF70CHT and SF70CHTE are approved.

(2) Effective January 1, 1978, couplers designated by the Association of American Railroads' Catalog Nos. SE67BHT, SE67BHTE, SE68BHT, SE68BHTE, SF73AHT, SF73AHTE, SF79CHT, and SF79CHTE are approved.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 179-11, 37 FR 3058, Feb. 11, 1972, as amended by Amdt. 179-20, 42 FR 61465, Dec. 5, 1977; Amdt. 179-21, 43 FR 7436, Feb. 23, 1978; Amdt. 179-27, 46 FR 8011, Jan. 26, 1981]

Subpart C—Specifications for Pressure Tank Car Tanks (Classes DOT-105, 109, 112, and 114)

§ 179.100 General specification applicable to pressure tank car tanks.

§ 179.100-1 Tanks built under these specifications shall comply with the requirements of §§ 179.100, 179.101 and when applicable, §§ 179.102, 179.103, and 179.104.

§ 179.100-2 Approval.

(a) For procedure for securing approval see § 179.3.

§ 179.100-3 Type.

(a) Tanks built under this specification shall be fusion-welded with heads designed convex outward. Except as provided in § 179.103 or § 179.104 they shall be circular in cross section, shall be provided with a manway nozzle on top of the tank of sufficient size to permit access to the interior, a manway cover to provide for the mounting of all valves, measuring and sampling devices, and a protective housing. Other openings in the tank are prohibited, except as provided in Part 173 of this chapter, §§ 179.100-14, 179.101-1 (a) Table Note 10, 179.102 or § 179.103.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21344, Nov. 6, 1971]

§ 179.100-4 Insulation.

(a) If insulation is applied, the tank shell and manway nozzle must be insulated with an approved material. The entire insulation must be covered with a metal jacket of a thickness not less than 11 gauge (0.1196 inch) nominal (Manufacturers' Standard Gauge) and flashed around all openings so as to be weather-tight. The exterior surface of a carbon steel tank, and the inside surface of a carbon steel jacket must be given a protective coating except that a protective coating is not required when foam-in-place insulation that adheres to the tank or jacket is applied.

(b) If insulation is a specification requirement, it shall be of sufficient thickness so that the thermal conductance at 60° F is not more than 0.075 Btu per hour, per square foot, per degree F temperature differential. If exterior heaters are attached to tank, the thickness of the insulation over each heater element may be reduced to one-half that required for the shell.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21344, Nov. 6, 1971]

§ 179.100-5 Bursting pressure.

(a) The minimum required bursting pressure is listed in § 179.101.

§ 179.100-6 Thickness of plates.

(a) The wall thickness after forming of the tank shell and heads must not be less than that specified in § 179.101, nor that calculated by the following formula:

$$t = Pd/2SE$$

where:

d = Inside diameter in inches;
E = 1.0 welded joint efficiency; except for heads with seams = 0.9;
P = Minimum required bursting pressure in p.s.i.;
S = Minimum tensile strength of plate material in p.s.i., as prescribed in § 179.100-7;
t = Minimum thickness of plate in inches after forming.

(b) If plates are clad with material having tensile strength properties at least equal to the base plate, the cladding may be considered a part of the base plate when determining thickness. If cladding material does not have tensile strength at least equal to the base plate, the base plate alone shall meet the thickness requirement.

(c) When aluminum plate is used, the minimum width of bottom sheet of tank shall be 60 inches, measured on the arc, but in all cases the width shall be sufficient to bring the entire width of the longitudinal welded joint, including welds, above the bolster.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21344, Nov. 6, 1971]

§ 179.100-7 Materials.

(a) *Steel plate:* Steel plate materials used to fabricate tank shell and manway nozzle must comply with one of the following specifications with the indicated minimum tensile strength and elongation in the welded condition. The maximum allowable carbon content must be 0.31 percent when the individual specification allows carbon greater than this amount. The plates may be clad with other approved materials.

Specifications	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM A 515-70, Gr. 55	55,000	28
ASTM A 515-70, Gr. 60	60,000	25
ASTM A 515-70, Gr. 65	65,000	20
ASTM A 515-70, Gr. 70	70,000	20
ASTM A 285-70a, Gr. A	45,000	29
ASTM A 285-70a, Gr. B	50,000	20
ASTM A 285-70a, Gr. C	55,000	20
ASTM A 516-70a, Gr. 55	55,000	28
ASTM A 516-70a, Gr. 60	60,000	25
ASTM A 516-70a, Gr. 65	65,000	20
ASTM A 516-70a, Gr. 70	70,000	20
AAR TC128-70, Gr. A and B	81,000	19
ASTM A 537-70, Gr. A	70,000	23
ASTM A 302-70a, Gr. B	80,000	20

[1] Maximum stresses to be used in calculations.

(b) *Aluminum alloy plate:* Aluminum alloy plate material used to fabricate tank shell and manway nozzle must be suitable for fusion welding and must comply with one of the following specifications with its indicated minimum tensile strength and elongation in the welded condition.

Specifications	Minimum tensile strength (p.s.i.) 0 temper, welded condition [3] [6]	Minimum elongation in 2 inches (percent) 0 temper, welded condition (longitudinal)
ASTM B 209-70, Alloy 5052 [1]	25,000	18
ASTM B 209-70, Alloy 5083 [2]	38,000	16
ASTM B 209-70, Alloy 5086 [1]	35,000	14
ASTM B 209-70, Alloy 5154 [1]	30,000	18
ASTM B 209-70, Alloy 5254 [1]	30,000	18
ASTM B 209-70, Alloy 5454 [1]	31,000	18
ASTM B 209-70, Alloy 5652 [1]	25,000	18
ASTM B 209-70, Alloy 6061 [4]	[5] 24,000	[5] 5

[1] For fabrication, the parent plate material may be 0, H112, or H32 temper, but design calculations must be based on minimum tensile strength shown.

[2] 0 temper only.

[3] Weld filler metal 5556 must not be used.

[4] Not authorized for tank shells, manways or domes.

[5] T6 temper only.

[6] Maximum stress to be used in calculations.

(c) All attachments welded to tank shell must be of approved material which is suitable for welding to the tank.

[Amdt. 179-10, 36 FR 21344, Nov. 6, 1971]

§ 179.100-8 Tank heads.

(a) The tank head shape shall be an ellipsoid of revolution in which the major axis shall equal the diameter of the shell adjacent to the head and the minor axis shall be one-half the major axis.

(b) Each tank head made from steel which is required to be "fine grain" by the material specification, which is hot formed at a temperature exceeding 1700° F., must be normalized after forming by heating to a temperature between 1550° and 1700° F., by holding at that temperature for at least 1 hour per inch of thickness (30-minute minimum), and then by cooling in air. If the material specification requires quenching and tempering, the treatment specified in that specification must be used instead of the one specified above.

[29 FR 18995, Dec. 29, 1964. Redesignated, 32 FR 5606, Apr. 5, 1967 and amended by Amdt. 179-12, 39 FR 15038, Apr. 30, 1974]

§ 179.100-9 Welding.

(a) All joints shall be fusion-welded in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W. Welding procedures, welders and fabricators shall be approved. Also see § 179.104.

§ 179.100-10 Postweld heat treatment.

(a) After welding is complete, steel tanks and all attachments welded thereto must be postweld heat treated as a unit in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W.

(b) For aluminum tanks, postweld heat treatment is prohibited.

[Amdt. 179-10, 36 FR 21345, Nov. 6, 1971]

§ 179.100-11 Tank mounting.

(a) See §§ 179.10 and 179.104.3

§ 179.100-12 Manway nozzle, cover and protective housing.

(a) Manway nozzles must be of approved design of forged or rolled steel for steel tanks or of fabricated aluminum alloy for aluminum tanks, with access opening at least 18 inches inside diameter, or at least 14 inches by 18 inches around or oval. Nozzle must be welded to the tank and the opening reinforced in an approved manner in compliance with the requirements of AAR Specifications for Tank Cars, Appendix E, Figure E10.

(b) Manway cover shall be machined to approved dimensions and be of forged or rolled carbon or alloy steel, rolled aluminum alloy or nickel when required by the lading. Minimum thickness is listed in § 179.101. Manway cover shall be attached to manway nozzle by through or stud bolts not entering tank, except as provided in § 179.103-2(a).

(c) Except as provided in § 179.103, protective housing of cast, forged or fabricated approved materials must be bolted to manway cover with not less than twenty ¾-inch studs. The shearing value of the bolts attaching protective housing to manway cover must not exceed 70 percent of the shearing value of bolts attaching manway cover to manway nozzle. Housing must have steel sidewalls not less than three-fourths inch in thickness and must be equipped with a metal cover not less than one-fourth inch in thickness that can be securely closed. Housing cover must have suitable stop to prevent cover striking loading and unloading connections and be hinged on one side only with approved riveted pin or rod with nuts and cotters. Openings in wall of housing must be equipped with screw plugs or other closures.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21345, Nov. 6, 1971]

§ 179.100-13 Venting, loading and unloading valves, measuring and sampling devices.

(a) Venting, loading and unloading valves shall be of approved design, made of metal not subject to rapid deterioration by the lading, and shall withstand the tank test pressure without leakage. The valves shall be directly bolted to seatings on manway cover, except as provided in § 179.103. Valve outlets shall be closed with approved screw plugs or other closures fastened to prevent misplacement.

(b) The interior pipes of the loading and unloading valves shall be anchored and, except as prescribed in § 179.102 or § 179.103, may be equipped with excess flow valves of approved design.

(c) Gauging device, sampling valve and thermometer well are not specification requirements. When used, they shall be of approved design, made of metal not subject to rapid deterioration by the lading, and shall withstand the tank test pressure without leakage. Interior pipes of the gauging device and sampling valve, except as prescribed in § 179.102 or § 179.103, may be equipped with excess flow valves of approved design. Interior pipe of the thermometer well shall be anchored in an approved manner to prevent breakage due to vibration. The thermometer well shall be closed by an approved valve attached close to the manway cover, or other approved location, and closed by a screw plug. Other approved arrangements that permit testing thermometer well for leaks without complete removal of the closure may be used.

(d) An excess flow valve as referred to in this specification, is a device which closes automatically against the outward flow of the contents of the tank such as may be encountered in case the external closure valve is broken off or removed during transit. Excess flow valves may be designed by the by-pass to allow the equalization of pressures.

(e) Bottom of tank shell may be equipped with a sump or siphon bowl, or both, welded or pressed into the shell. Such sumps or siphon bowls, if applied, are not limited in size and must be made of cast, forged or fabricated metal. Each sump or siphon bowl must be of good welding quality in conjunction with the metal of the tank shell. When the sump or siphon bowl is pressed in the bottom of the tank shell, the wall thickness of the pressed section must not be less than that specified for the shell. The section of a circular cross section tank to which a sump or siphon bowl is attached need not comply with the out-of-roundness requirement specified in AAR Specifications for Tank Cars, Appendix W, W14.06. Any portion of a sump or siphon bowl not forming a part of cylinder of revolution must have walls of such thickness and be so reinforced that the stresses in the walls caused by a given internal pressure are no greater than the circumferential stress which would exist under the same internal pressure in the wall of a tank of circular cross section designed in accordance with § 179.100-6(a). In no case less than that specified in § 179.101-1(a).

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21345, Nov. 6, 1971]

§ 179.100-14 Bottom outlets.

(a) Bottom outlets for discharge of lading is prohibited, except as provided in § 179.103-3. If indicated in § 179.101, tank may be equipped with a bottom washout of approved construction. If applied, bottom washout shall be in accordance with the following requirements.

(1) On newly built and empty cars with truck centers through 60 feet, 6 inches, the extreme projection of the bottom washout equipment must be at least 12 inches above the top of rail on level track. On cars with truck centers greater than 60 feet, 6 inches, the minimum rail clearance must be in accordance with the graph in Appendix E of the AAR Specifications for Tank Cars.

(2) Bottom washout shall be of cast, forged or fabricated metal and shall be fusion-welded to the tank. It shall be of good weldable quality in conjunction with metal of tank.

(3) If bottom washout nozzle extends 6 inches or more from shell of tank, a "V" groove must be cut (not cast) in the upper part of the nozzle at a point immediately below the lowest part of inside closure seat or plug to a depth that will leave wall thickness of nozzle at the root of the "V" not over one-fourth inch. Where nozzle is not a single piece, provision must be made for the equivalent of the breakage groove. The nozzle must be of a thickness to insure that accidental breakage will occur at or below the "V" groove or its equivalent. On cars without continuous center sills, the breakage groove or its equivalent must not be more than 15 inches below the tank shell. On cars with continuous center sills, the breakage groove or its equivalent must be above the bottom of the center sill construction.

(4) The closure plug and seat shall be readily accessible or removable for repairs.

(5) The closure of the washout nozzle must be equipped with a ¾-inch solid screw plug. Plug must be attached by at least a ¼-inch chain.

(6) Joints between closures and their seats may be gasketed with suitable material.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21345, Nov. 6, 1971]

§ 179.100-15 Safety relief valves.

(a) The tank must be equipped with one or more safety relief valves of approved design, made of metal not subject to rapid deterioration by the lading. The safety relief valve, or valves, must be mounted on manway cover, except as provided in § 179.103. The total valve discharge capacity must be sufficient to prevent building up pressure in tank in excess of 82½ percent of the tank test pressure or 10 p.s.i. above the start-to-discharge pressure, whichever is higher. The start-to-discharge and vapor-tight pressures must comply with § 179.101 and must not be affected by any auxiliary closure or other combination. For certain commodities, alternate pressures are permitted (see § 179.102-11). See AAR Specifications for Tank Cars, Appendix A, for formula for calculating discharge capacity.

(b) When a safety relief valve is used in combination with a breaking pin device, the breaking pin device must be designed to fail at a pressure of 75 percent of the tank test pressure and safety relief valve must be set for a start-to-discharge pressure of 71 percent of the tank test pressure. However, for spec. DOT-105A500W tanks, the start-to-discharge pressure must be 360 p.s.i. For certain commodities, alternate pressures are permitted (see § 179.102-11).

(c) When a safety relief valve is used in combination with a frangible disc, the frangible disc must be designed to burst at a pressure of 75 percent of the tank test pressure and the safety relief valve must be set for a start-to-discharge pressure of 71 percent of the tank test pressure, as prescribed in § 179.101. Provisions must be made to prevent any accumulation of pressure between the frangible disc and safety relief valve. For certain commodities, alternate pressures are permitted (see § 179.102-11).

[Amdt. 179-10, 36 FR 21346, Nov. 6, 1971]

§ 179.100-16 Attachments.

(a) Reinforcing pads must be used between external brackets and shells if the attachment welds exceed 6 linear inches of ¼-inch fillet or equivalent weld per bracket or bracket leg. When reinforcing pads are used, they must not be less than one-fourth inch in thickness, have each corner rounded to a 1-inch minimum radius, and be attached to the tank by continuous fillet welds except for venting provisions. The ultimate shear strength of the bracket-to-reinforcing pad weld must not exceed 85 percent of the ultimate shear strength of the reinforcing pad-to-tank weld.

(b) Attachments not otherwise specified shall be applied by approved means.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21346, Nov. 6, 1971]

§ 179.100-17 Closures for openings.

(a) Closures shall be of approved design and made of metal not subject to rapid deterioration by the lading. Plugs, if used, shall be solid, with NPT threads, and shall be of a length which will screw at least six threads inside the face of fitting or tank.

§ 179.100-18 Tests of tanks.

(a) Each tank shall be tested by completely filling tank and manway nozzle with water or other liquid having similar viscosity, at a temperature which shall not exceed 100° F during the test; and applying the pressure prescribed in § 179.101. The tank shall hold the prescribed pressure for at least 10 minutes without leakage or evidence of distress.

(b) Insulated tanks shall be tested before insulation is applied.

(c) Calking of welded joints to stop leaks developed during the foregoing test is prohibited. Repairs in welded joints shall be made as prescribed in AAR specifications for Tank Cars, Appendix W.

(d) Testing of exterior heaters is not a specification requirement.

§ 179.100-19 Tests of safety relief valves.

(a) Each valve shall be tested by air or gas for compliance with § 179.101 before being put into service.

§ 179.100-20 Stamping.

(a) To certify that the tank complies with all specification requirements, each tank shall be plainly and permanently stamped in letters and figures at least ⅜ inch high into the metal near the center of both outside heads as follows:

	Example of required stamping
Specification	DOT-105A100W
Material	ASTM A515-70
Cladding material (if any)	ASTM A240-304
Tank builder's initials	Clad
Date of original test	ABC
Car assembler (if other than tanker builder).	00-0000 DEF
Water capacity	00000 lbs.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21346, Nov. 6, 1971]

§ 179.100–21 Stenciling.

(a) The tank or the jacket if tank is insulated, shall be stenciled in compliance with the requirements of AAR Specifications for Tank Cars, Appendix C.

(b) Water capacity stencil is required.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and as amended by Amdt. 179-10, 36 FR 21346, Nov. 6, 1971]

§ 179.100–22 Certificate of construction.

(a) See § 179.5.

§ 179.100–23 Alternative requirements for tank head puncture resistance systems.

(a) Tank cars required to have puncture resistance systems in accordance with § 179.105-5 may, as an alternative, be equipped with a head shield at each end of the car in accordance with the requirements of this section. The shield must be:

(1) At least ½-inch thick, and made from steel produced in accordance with specifications ASTM A242, A572-GR50, A515-70, A516-GR70, or AAR TC-128B.

(2) In the shape and size of the lower half of the head of the tank car or in the shape of a trapezoid with the following dimensions:

(i) A minimum width at the top of the center sill of four feet six inches, measured in a straight line between extreme edges,

(ii) A minimum width at the top of shield of nine feet measured in a straight line between the extreme edges; (For cars with diameters less than nine feet, the width of the head shield must not extend beyond outermost portion of the head and be not less than three inches from the outermost point of the head.)

(iii) The top corners of the shield rounded to a minimum radius of 9 inches;

(iv) The bottom corners of the shield rounded to a minimum radius of 3 inches;

(v) All inside edges of the shield chamfered to a minimum of ⅛-inch;

(vi) A minimum height of four feet six inches, and

(vii) Located so that the bottom of the shield touches the top of the center sill.

(3) Shaped to the contour of the tank shell head, utilizing a minimum of three vertical bend lines; and

(4) The head protection device must meet the impact test requirements of paragraph AAR. 24-5 in the "Specifications for Tank Cars" Standard, effective October 1, 1972. The impact test acceptance criterion is that the device and its supporting structure does not sustain visible permanent damage or deformation such as fractures, cracks, bends, and dents. The object of this requirement is to assure that the head shield has adequate strength to remain attached and functionally unimpaired during normal operations.

(b) The head protection device must meet all of the workmanship requirements of the "AAR Specifications for Design, Fabrication and Construction of Freight Cars, dated September 1, 1964."

[Amdt. 179-15, 39 FR 27574, July 30, 1974; as amended by Amdt. 179-16, 41 FR 21476, May 26, 1976; Amdt. 179-27, 46 FR 8011, Jan. 26, 1981]

§ 179.101 Individual specification requirements applicable to pressure tank car tanks.

§ 179.101-1 Individual specification requirements.

(a) In addition to § 179.100 the individual specification requirements are as follows:

DOT specifications	105A100ALW	105A100W	105A200ALW	105A200F	105A200W	105A300ALW	105A300W	105A400W	105A500W	105A600W
Material (see 179.100-7)	Al alloy	Steel	Al alloy	Steel	Steel	Al alloy	Steel	Steel	Steel	Steel
Insulation (see 179.100-4)	Required	Required	Required	Required	Required	Required	Required	Required	Required	Required
Bursting pressure, p.s.i. (see 179.100-5)	500	500	500		500	750	750	1,000	1,250	1,500
Minimum plate thickness, inches, shell and heads	⅝	[3] 9/16	⅝	[5] 9/16	[3] 9/16	⅝	[1] 11/16	[1] 11/16	[1] 11/16	[1] 11/16
Test pressure, p.s.i. (see 179.100-18)	100	100	200	See 179.104	200	300	300	400	500	600
Safety relief valves, p.s.i.:[8]										
Start-to-discharge Pressure, p.s.i.	75	75	150	150	150	225	225	300	375	450
Start-to-discharge Tolerance, p.s.i	±3.0	±3.0	±4.5	±4.5	±4.5	±6.75	±6.75	±9.0	±11.25	±13.5
Vapor tight (minimum) Pressure, p.s.i.	60	60	120	120	120	180	180	240	300	360
Value flow rating pressure (maximum p.s.i.)	85	85	165	165	165	247.5	247.5	330	412.5	495
Manway cover, thickness, inches (minimum)	[2] 2½	2½	[2] 2½	2¼	2¼	[2] 2⅝	[9] 2¼	[9] 2¼	2¼	2¼
Special references	179.102-3	179.102-3 179.102-6 179.102-12 179.102-17 179.102-20	179.102-3	179.102-3 179.102-17 179.104	179.102-3 179.102-6 179.102-17	179.102-3	179.102-2 179.102-3 179.102-5 179.102-6 179.102-7 179.102-8 179.102-11 179.102-13 179.102-15 179.102-16 179.102-17	179.102-3 179.102-17	179.102-1 179.102-2 179.102-3 179.102-9 179.102-10 179.102-14 179.102-18	179.102-1 179.102-3 179.102-4 179.102-9 179.102-10 179.102-17
Bottom washout	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited
Bottom outlet	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited

DOT specifications	109A100ALW	109A200ALW	109A300ALW	109A300W	112A200W[12]	112A340W[12]	112A400F[11]	112A400W[12]	112A500W[12]	114A340W[12]	114A400W[12]
Material (see 179.100-7)	Al alloy	Al alloy	Al alloy	Steel	Steel	Steel	Steel	Steel	Steel	Steel	Steel
Insulation (see 179.100-4)	Optional	Optional	Optional	Optional	[4] None	[4] None		[4] None	[4] None	[4] None	[4] None

Bursting pressure, p.s.i. (see 179.100-5)	500	500	750	750	500	850		1,000	1,250	850	1,000
Minimum plate thickness, inches, shell and heads	5/8	5/8	5/8	[1] 11/16	[3] [5] [1] 9/16	[1] 11/16		[1] 11/16	[1] 11/16	[1] 11/16	[1] 11/16
Test pressure, p.s.i. (see 179.100-18)	100	200	300	300	200	340		400	500	340	400
Safety relief valves, p.s.i.: [8]											
Start-to-discharge	75	150	225	225	150	225		300	375	225	200
Pressure, p.s.i.											
Start-to-discharge											
Tolerance, p.s.i.	±3.0	±4.5	±6.75	±6.75	±4.5	±7.65		±9.0	±11.25	±7.65	±9.0
Vapor tight (minimum)											
Pressure, p.s.i.	60	120	180	180	120	204		240	300	204	240
Value flow rating											
Pressure (maximum p.s.i.)	85	165	247.5	247.5	165	280.5		330	412.5	280.5	330
Manway cover, thickness, inches (minimum)	[3] 2½	[2] 2½	[2] 2⅝	2¼	2¼	2¼		2¼	2¼	(7)	(7)
Special references					[10] 179.102-3 179.102-17	[10] 179.102-3 179.102-11 179.102-17		[10] 179.102-3 179.102-6 179.102-11 179.102-13 179.102-17	[10] 179.102-3 179.102-17	179.102-11 179.103 179.102-17	179.102-11 179.103 179.102-13 179.102-17
Bottom washout	Optional	Optional	Optional	Optional	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Optional	Optional
Bottom outlet	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Optional	Optional

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[1] When steel of 65,000 to 81,000 p.s.i. minimum tensile strength is used, the thickness of plates shall be not less than ⅝ inch, and when steel of 81,000 p.s.i. minimum tensile strength is used, the minimum thickness of plate shall be not less than 9/16 inch.

[2] When approved material other than aluminum alloys are used, the thickness shall be not less than 2¼ inches.

[3] When steel of 65,000 p.s.i. minimum tensile strength is used, minimum thickness of plates shall be not less the ½ inch.

[4] At least the upper two-thirds of the exterior of the tank manway nozzle and alll appurtenances in contact with this area of the tank shall have a finish coat of white paint.

[5] For inside diameter of 87 inches or less, the thickness of plates shall be not less than ½ inch.

[6] Sec. § 179.102-11 for optional setting for certain commodities.

[7] See AAR specifications for tank cars, appendix E, E4.01 and § 179.103-2.

[8] Purposely left blank.

[9] When the use of nickel is required by the lading, the thickness shall not be less than 2 inches.

[10] Each tank head may be equipped with not more than one opening for use in purging tank interior.

[11] Tanks converted to DOT-112A400F from existing forge-welded specification DOT-105A500 tanks by modification using conversion details complying with DOT-112A400W specification requirements, shall be stenciled by substituting the letter "F" for the letter "W" in the specification designation.

[12] When tank car head shields meeting the requirements of § 179.100 have been applied, an "S" must be substituted for the "A" in the specification marking.

(49 CFR 1.53(g))

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21346, Nov. 6, 1971; Amdt. 179-16, 41 FR 21476, May 26, 1976]

§ 179.102 Special commodity requirements for pressure tank car tanks.

(a) In addition to §§ 179.100 and 179.101 the following requirements are applicable:

§ 179.102-1 Liquefied carbon dioxide.

(a) Tank cars used to transport liquefied carbon dioxide must comply with the following special requirements:

(1) All plates for tank, manway nozzle and anchorage of tanks used in the transportation of liquid carbon dioxide must be made of carbon steel complying with ASTM Specification A300-68, Class 1. Impact specimens must be Type A Charpy V-notch as shown in ASTM Specification A370-68 and must meet the impact requirements at minus 50° F. using steel meeting requirements of ASTM Specification A516-70a, Grade 55, 60, 65, or 70, or AAR Specification TC128-70, Grade B. Production-welded test plates prepared as required by W4.00 of AAR Specifications for Tank Cars, Appendix W, must include impact test specimens of weld metal and head-affected zone.

(2) Tank shall be insulated with an approved material of sufficient thickness so that the thermal conductance at 60 F is not more than 0.03 Btu per hour per square foot per degree F temperature differential; except that in order to permit an anchorage which shall not exceed seven inches from top of center sills to bottom of tank, the insulation thickness directly over the sills may be reduced to give thermal conductance not exceeding 0.04 Btu per hour per square foot per degree F temperature differential.

(3) Tank shall be equipped with one safety relief valve set for the start-to-discharge pressure listed in § 179.101, and one safety vent of approved design, set to function at a pressure less than the tank test pressure, and not less than 75 percent of tank test pressure. The discharge capacity of each of these safety relief devices shall be sufficient to prevent building up pressure in tank in excess of 82½ percent of the tank test pressure.

(4) Tank shall be equipped with two pressure-regulating valves of approved design, set to open at a pressure not exceeding 450 psi on spec. 105A500-W tanks or 400 psi on spec. 105A600-W tanks.

(5) Each regulating valve and safety relief device shall have its final discharge piped to the outside of the protective housing.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21347, Nov. 6, 1971]

§ 179.102-2 Chlorine.

(a) Each tank car used to transport chlorine must comply with all of the following:

(1) Each tank must be constructed in compliance with spec. DOT-105A500W. A tank car must be operated and the jacket stenciled either DOT-105A300W or DOT-105A500W, and each tank must be equipped with the safety relief valve required by the stenciled specification.

(2) Interior pipes of liquid discharge valves must be equipped with excess flow valves of approved design.

(3) Insulation must be 4 inches minimum thickness of corkboard or of self-extinguishing polyurethane foam.

(4) Tanks must be fabricated from carbon steel complying with ASTM Specification A516-70a, Grade 70, or AAR Specification TC-128-70, Grade A or B.

(Department of Transportation Act, 49 U.S.C. 1657; 49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 179-7, 36 FR 14697, Aug. 10, 1971; Amdt. 179-10, 36 FR 21346, Nov. 6, 1971, as amended by Amdt. 179-25, 44 FR 20433, Apr. 5, 1979]

§ 179.102-3 Liquefied flammable gases.

(a) Any authorized tank car used to transport liquefied flammable gases must comply with the following special requirements:

(1) The interior pipes of the loading and unloading valves and sampling

valves, also the gaging device when it provides a means for passage of the lading from the interior to the exterior of the tank, must be equipped with excess flow valves of an approved design. If the opening for passage of lading through the gain device is not more than 0.060-inch diameter, an excess flow valve is not required.

(2) The protective housing cover must be provided with an opening above each safety relief valve which must be concentric with the discharge of the valve and have an area at least equal to the valve outlet area. Each opening must be provided with a weatherproof cover designed for vertical discharge.

(3) Gaskets for manway cover plates and for mounting of fittings must be asbestos type or approved high-temperature resistant equivalent.

[Amdt. 179-10, 36 FR 21347, Nov. 6, 1971]

§ 179.102-4 Vinyl fluoride, inhibited.

(a) Spec. 105A600-W tank cars used to transport vinyl fluoride, inhibited, shall comply with the following special requirements:

(1) Tank shall be insulated with an approved material of sufficient thickness so that the thermal conductance at 60 F is not more than 0.03 Btu per hour per square foot per degree F temperature differential; except that in order to permit an anchorage which shall not exceed seven inches from top of center sill to bottom of tank, the insulation thickness directly over the sills may be reduced to give thermal conductance not exceeding 0.04 Btu per hour per square foot per degree F temperature differential.

(2) Tank shall be equipped with one safety relief valve, set for the start-to-discharge pressure listed in § 179.101, and one safety vent of approved design, set to function at a pressure less than the tank test pressure and not less than 75 percent of the tank test pressure. The discharge capacity of each of these safety relief devices shall be sufficient to prevent building up pressure in tank in excess of 82½ percent of the tank test pressure.

(3) Each regulating valve and safety relief device shall have its final discharge piped to the outside of the protective housing.

§ 179.102-5 Nitrosyl chloride.

(a) Tank cars used to transport nitrosyl chloride must comply with the following special requirements:

(1) Tanks shall be made of or clad with a metal not subject to rapid deterioration by the lading; all appurtenances such as manway covers, venting, loading and unloading valves, safety relief valves, excess flow valves, and reduction pipes, shall be made of metal not subject to rapid deterioration by the lading; cork shall be used as an insulating material.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21347, Nov. 6, 1971]

§ 179.102-6 Vinyl chloride or vinyl methyl ether, inhibited.

(a) Tank cars used to transport vinyl chloride, or vinyl methyl ether, inhibited, must comply with the following special requirements:

(1) All parts of valves and safety relief devices in contact with the lading must be of a metal or other material suitably treated, if necessary, which will not cause formation of any acetylides.

(2) The interior pipes of the loading and unloading valves and sampling valve, also the gaging device when it provides a means for passage of the lading from the interior to the exterior of the tank, must be equipped with excess flow valves of an approved design. If the opening for passage of lading through the gauging device is not more than 0.060 inch diameter, an excess flow valve is not required.

(3) [Reserved]

(4) For alternate safety relief valve settings, see § 179.102-11.

(5) For gasket requirements, see § 179.102-11(b).

[Amdt. 179-10, 36 FR 21347, Nov. 6, 1971; Amdt. 179-14, 39 FR 24910, July 8, 1974]

§ 179.102-7 Bromine.

(a) Tank cars used to transport bromine must comply with the following special requirements:

(1) The tank shall be nickel clad at least 20 percent or shall be lined with lead at least ³⁄₁₆ inch thick; openings in tank heads to facilitate application of

lead lining are authorized if closed in an approved manner; all closures and appurtenances in contact with the lading shall be lead lined or shall be made of metal not subject to rapid deterioration by the lading; all interiors welds in nickel clad tanks shall be protected by pure nickel butt straps to eliminate iron contamination. Except as otherwise provided herein, the water weight capacity of the tank shall not exceed 20,400 pounds. When tanks are equipped with manway cover plates, safety relief valves, venting, loading and unloading valves in accordance with spec. 105A300-W, and tank jackets are stenciled spec. 105A300-W, but in all other respects are constructed and maintained in full compliance with spec. 105A500-W, the water weight capacity of the tank shall not exceed 37,400 pounds.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21347, Nov. 6, 1971]

§ 179.102-8 Motor fuel anti-knock compound.

(a) Tank cars used to transport motor fuel antiknock compounds must comply with the following special requirements:

(1) Openings in tank heads to facilitate application of nickel lining are authorized if closed in an approved manner.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 179.102-8 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 179.102-9 Nitrogen tetroxide or Nitrogen tetroxide-nitric oxide mixtures.

(a) Tank cars used to transport nitrogen tetroxide or nitrogen tetroxide-nitric oxide mixtures must comply with the following special requirements:

(1) Tanks must be insulated with not less than four inches of corkboard. All valves and fittings must be protected by the securely attached cover made of metal not subject to rapid deterioration by the lading, and all valve openings, except the safety relief valves, must be fitted with screw plugs or caps to prevent leakage in the event of valve failure. Safety relief valve must be equipped with an approved stainless steel or platinum frangible disc. Written procedures covering details of tank car appurtenances, manway fittings and safety relief devices, and marking, loading, handling, inspection and testing practices, must be filed with and approved by the Bureau of Explosives before any tank car is offered for transportation of these commodities.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21347, Nov. 6, 1971; Amdt. 179-25, 44 FR 20433, Apr. 5, 1979]

§ 179.102-10 Hydrocyanic acid.

(a) Tank cars used to transport hydrocyanic acid must comply with the following special requirements:

(1) Each tank car must be registered and the jacket stenciled "DOT-105A300W" and be equipped with the safety relief valves required by that specification. Tanks must be insulated with not less than four inches of corkboard. Written procedures covering details of tank car appurtenances, manway fittings and safety relief devices, and marking, loading, handling, inspection and testing practices must be filed with and approved by the Bureau of Explosives before any tank car is offered for transportation of hydrocyanic acid.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21347, Nov. 6, 1971; Amdt. 179-25, 44 FR 20433, Apr. 5, 1979]

§ 179.102-11 Liquefied petroleum gas, butadiene, anhydrous ammonia, methylacetylene-propadiene, stabilized, or vinyl chloride.

(a) Tank cars used to transport liquified petroleum gas, butadiene, anhydrous ammonia, methylacetylene-propadiene, stabilized, or vinyl chloride may as an alternate comply with the following special requirements:

(1) Safety relief valves may be set to the following pressures, provided the total valve discharge capacity is sufficient to prevent building up pressure

in the tank in excess of 90 percent of the tank test pressure.

Safety relief valves, p.s.i.	DOT specifications		
	105A-300W	112A-340W, 114A-340W	112A-400W, 114A-400W
Start-to-discharge pressure	247.5	280.5	330
Start-to-discharge tolerance	±7.5	±8.4	±10
Vapor tight pressure (minimum)	196	224	264
Flow rating pressure	270	306	360

(b) Gaskets for manway covers and for mounting of fittings must be asbestos type or approved high-temperature resistant equivalent.

[Amdt. 179-10, 36 FR 21347, Nov. 6, 1971]

§ 179.102-12 Ethylene oxide.

(a) Each tank car used to transport ethylene oxide must be constructed to be in compliance with the following special requirements:

(1) The tank must be constructed in accordance with DOT-105A ***W specification, and its jacket stenciled "DOT-105A100W."

(2) Each safety relief valve must be in compliance with the requirements specified in the DOT-105A100W tank car specification. Each safety relief valve must have its discharge piped to the top of the manway bonnet assembly. Vapor exit from the assembly must be provided through a full opening weather cap located directly above the safety valve vent pipe.

(3) Copper, silver, mercury, magnesium, or their alloys may not be used in any part of the tank or appurtenances if that part of appurtenance is normally in contact with ethylene oxide liquid or vapor.

(4) Interior pipes of liquid discharge valves, vapor lines, gaging devices (when the device provides a means for passage of the lading from the interior to the exterior of the tank) and sampling lines must be equipped with excess flow valves of an approved design.

(5) Each tank must be equipped with a thermometer well.

(6) Each tank must be insulated with glass fiber except tank cars built before January 31, 1975, are authorized in this service when insulated with cork.

(7) The manway protective housing and cover must be insulated with glass fiber or other material that will provide protection against heat deterioration of the valves and any resilient material contained within the housing. Compliance with this provision is required after January 31, 1975, except that tank cars which are not in compliance and were built before January 31, 1975, must be in compliance by July 31, 1976.

(8) Neoprene, natural rubber, and asbestos gaskets are prohibited. All O-rings, packings and gaskets must be constructed of materials which do not react spontaneously with or lower the autoignition temperature of ethylene oxide.

(9) Each tank built after August 31, 1981, shall be constructed in accordance with class 105J, except that the safety relief valve requirements of § 179.106-2(c)(4) shall not apply. Each tank built after August 31, 1982, shall be contructed in accordance with class 105J.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 179-14, 39 FR 24910, July 8, 1974, as amended by Amdt. 179-14A, 41 FR 3870, Jan. 27, 1976; Amdt. 179-25, 44 FR 20434, Apr. 5, 1979; Amdt. 179-27, 46 FR 8011, Jan. 26, 1981; Amdt. 179-27A, 46 FR 42679, Aug. 24, 1981]

§ 179.102-13 Hydrofluoric acid, anhydrous.

(a) Tank cars used to transport hydrofluoric acid, anhydrous, must comply with the following special requirements:

(1) Tanks must be equipped with valves and appurtenances approved for this particular service, made of metal not subject to rapid deterioration by the lading. For safety relief valves, see § 179.100-15 (b) and (c).

(2) For spec. DOT-114A400W tanks, valves and fittings must be located on the top of the tank.

(3) Bottom opening in tank prohibited.

[Amdt. 179-10, 36 FR 21347, Nov. 6, 1971]

§ 179.102-14 Acrolein inhibited.

Each tank car used to transport acrolein, inhibited, must be a Specification DOT-105A300W or higher rated tank, registered and the jacket stenciled "DOT-105A200W" and be equipped with the safety relief valve required by that specification.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 178-25, 44 FR 20434, Apr. 5, 1979]

§ 179.102-15 Sodium, metallic.

Tank cars used to transport metallic sodium must have exterior heater coils fusion welded to tank shell.

[Amdt. 179-10, 36 FR 21347, Nov. 6, 1971]

§ 179.102-16 Sulfur trioxide stabilized.

Tank cars used to transport sulfur trioxide stabilized must be equipped with safety relief valves of approved design. Tanks equipped with interior heating coils not permitted.

[Amdt. 179-10, 36 FR 21347, Nov. 6, 1971]

§ 179.102-20 Dimethyl hydrazine unsymmetrical.

Class DOT-105AW tank cars used to transport dimethyl hydrazine unsymmetrical must be stenciled DOT-105A-100W. Tanks must be equipped with steel or stainless steel safety relief valves of the type and size used on specification DOT-105A100W tank cars.

[Amdt. 179-14, 39 FR 24911, July 8, 1974]

§ 179.103 Special requirements for class 114A * * * tank car tanks.

(a) In addition to the applicable requirements of §§ 179.100 and 179.101 the following requirements shall be complied with:

§ 179.103-1 Type.

(a) Tanks built under this section may be of any approved cross section.

(b) Any portion of the tank shell not circular in cross section shall have walls of such thickness and be so reinforced that the stresses in the walls caused by a given internal pressure are no greater than the circumferential stresses which would exist under the same internal pressure in the wall of a tank of circular cross section designed in accordance with paragraphs § 179.100-6 (a) and (b), but in no case shall the wall thickness be less than that specified in § 179.101.

(c) Manway and cover may be located other than at the top of the tank.

(d) Valves and fittings need not be mounted on the manway cover.

(e) One opening may be provided in each head for use in purging the tank interior.

§ 179.103-2 Manway cover.

(a) Manway cover may be of the internal self-energizing type and shall be of approved design.

(b) If no valves or measuring and sampling devices are mounted on manway cover, no protective housing is required.

§ 179.103-3 Venting, loading and unloading valves, measuring and sampling devices.

(a) Venting, loading and unloading valves, measuring and sampling devices, when used, shall be attached to a nozzle or nozzles on the tank shell or heads.

(b) These valves and appurtenances must be grouped in one location and, except as provided in § 179.103-5, must be equipped with a protective housing with cover, or may be recessed into tank shell with cover. An additional set grouped in another location may be provided. Protective housing with cover, when used, must have steel sidewalls not less than three-fourths inch in thickness and a metal cover not less than one-fourth inch in thickness that can be securely closed. Underframe sills are an acceptable alternate to the protective housing cover, provided the arrangement is of approved design. For fittings recessed into tank shell, protective cover must be metal and not less than one-fourth inch in thickness.

(c) When tank car is used to transport liquefied flammable gases, the interior pipes of the loading, unloading, and sampling valves must be equipped with excess flow valves of approved design except when quick closing internal valves of approved design are used. When the interior pipe of the gaging device provides a means for the passage of lading from the interior to the exterior of the tank, it must be equipped with an excess flow valve of approved design or with an orifice not exceeding 0.060 inch.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21348, Nov. 6, 1971]

§ 179.103-4 Safety relief devices and pressure regulators.

(a) Safety relief devices and pressure regulators must be located on top of the tank near the center of the car on a nozzle, mounting plate or recess in the shell. Through or stud bolts, if use, must not enter the tank.

(b) Metal guard of approved design must be provided to protect safety relief devices and pressure regulators from damage.

[Amdt. 179-10, 36 FR 21348, Nov. 6, 1971]

§ 179.103-5 Bottom outlets.

(a) In addition to or in place of the venting, loading and unloading valves, measuring and sampling devices as prescribed in § 179.103-3, tanks may be equipped with approved bottom outlet valves. If applied bottom outlet valves must meet the following requirements:

(1) When external bottom outlet valve without interior pipes is used in liquefied flammable gas service, the valve opening must be closed with an internal bolted or self-energizing closure of approved design. Protective housing is not required. On cars with center sills, a ball valve may be welded to the outside bottom of the tank or mounted on a pad or nozzle with a tongue and groove or male and female flange attachment, but in no case shall the breakage groove or equivalent extend below the bottom flange of the center sill. On cars without continuous center sills, a ball valve may be welded to the outside bottom of the tank or mounted with a tongue and groove or male and female flange attachment on a pad attached to the outside bottom of the tank. The mounting pad must have a maximum thickness of 2½ inches measured on the longitudinal centerline of the tank. The valve operating mechanism must be provided with a suitable locking arrangement to insure positive closure during transit.

(2) When internal bottom outlet valve is used in liquefied flammable gas service, the outlet of the valve must be equipped with an excess flow valve of approved design, except when a quick-closing internal valve of approved design is used. Protective housing is not required.

(3) Bottom outlet valve must be equipped with a liquid tight closure at its lower end.

(b) Bottom outlet equipment must be of approved design and must meet the following requirements:

(1) On newly built empty cars with truck centers through 60 feet, 6 inches, the extreme projection of the bottom outlet equipment must be at least 12 inches above the top of rail on level track. On cars with truck centers greater than 60 feet, 6 inches, the minimum rail clearance must be in accordance with the graph in Appendix E of the AAR Specifications for Tank Cars. All bottom outlet reducers and closures and their attachments must be secured to car by at least ⅜-inch chain or its equivalent, except that outlet closure plugs may be attached by ¼-inch chain. When the bottom outlet closure is of the combination cap and valve type, the pipe connection to the valve must be closed by a plug, cap, or approved quick-coupling device.

(2) Bottom outlet must be provided with a liquid tight closure at its lowest end.

(3) The valve operating mechanism must be provided with a suitable locking arrangement to insure positive closure during transit.

(4) If outlet nozzle extends 6 inches or more from shell of tank, a breakage groove or its equivalent must be provided immediately below the lowest part of the valve. Breakage groove, if used, must consist of a "V" groove cut (not cast) in the nozzle to depth that will leave thickness of nozzle wall at the root of the "V" not over one-fourth inch. On cars without continuous center sills, the breakage groove or its equivalent must not be more than 15 inches below the tank shell. On cars with continuous center sills, the breakage groove or its equivalent must be above the bottom of the center sill construction.

(5) The valve body must be of a thickness which will insure that accidental breakage of the outlet nozzle will occur at or below the "V" groove, or its equivalent, and will not cause distortion of the valve seat or valve.

[Amdt. 179-10, 36 FR 21349, Nov. 6, 1971]

§ 179.104 Special requirements for spec. 105A200-F tank car tanks.

§ 179.104-1 Tanks built under these specifications must meet the requirements of §§ 179.100, 179.101, and when applicable §§ 179.102 and 179.104.

[Amdt. 179-10, 36 FR 21348, Nov. 6, 1971]

§ 179.104-2 Type.

(a) Tanks built under this specification shall be fabricated by conversion from existing forge-welded steel tanks complying with specs. 105A300, 105A400, 105A500 or 105A600.

§ 179.104-3 Tank mounting.

(a) The use of rivets as a means of attaching anchor to tank is permitted.

§ 179.104-4 Welding.

(a) All joints shall be lap welded by the water gas process, hammered or rolled or other lap welded, hammered or rolled process which investigation and laboratory tests by the Mechanical Division of the AAR have proved will produce satisfactory results.

§ 179.105 Special requirements for Specifications 112 and 114 tank cars.

[Amdt. 179-19, 42 FR 46313, Sept. 15, 1977]

§ 179.105-1 General.

(a) In addition to the requirements of this section, each tank car built under specification 112 and 114 must meet the applicable requirements of §§ 179.100, 179.101, 179.102, and 179.103.

(b) Notwithstanding the provisions of §§ 179.3, 179.4, and 179.6, AAR approval is not required for changes in or additions to specifications 112 and 114 tank cars necessary to comply with this section.

(c) Notwithstanding the provisions of § 173.8 of this subchapter, no. 112 and 114 tank car manufactured to specifications promulgated by the Canadian Transport Commission may be used:

(1) After March 31, 1979, to transport hazardous materials in the United States unless it is equipped with a coupler vertical restraint system under § 179.105-6, except that an "empty" tank car § 172.510(c) of this subchapter) may be returned to Canada without a coupler vertical restraint system July 1, 1979; nor

(2) After December 31, 1980, to transport flammable gases in the United States unless it is equipped with thermal protection under § 179.105-4 and tank head puncture resistance under § 179.105-5; and, to transport anhydrous ammonia in the United States unless it is equipped with tank head puncture resistance under § 179.105-5.

(d) As used in this § 179.105, "tank car owner" means a person whose reporting mark appears on any specification 112 or 114 tank car.

[Amdt. 179-19, 42 FR 46313, Sept. 15, 1977, as amended by Amdt. 179-23, 43 FR 30061, July 13, 1978; Amdt. 179-24, 43 FR 39793, Sept. 7, 1978]

§ 179.105-2 New cars.

(a) Each specification 112A and 114A tank car built after December 31, 1977, shall be equipped with a coupler restraint system that meets the requirements of § 179.105-6.

(b) Each specification 112S and 114S tank car built after December 31, 1977, shall be equipped with:

(1) A coupler restraint system that meets the requirements of § 179.105-6; and

(2) A tank head puncture resistance system that meets the requirements of § 179.105-5.

(c) Each specification 112T, 112J, 114T, and 114J tank car built after December 31, 1977, shall be equipped with:

(1) A coupler restraint system that meets the requirements of § 179.105-6;

(2) A tank head puncture resistance system that meets the requirements of § 179.105-5;

(3) A thermal protection system that meets the requirements of § 179.105-4; and

(4) A safety relief valve that meets the requirements of § 179.105-7.

(d) Each specification 112 and 114 tank car shall be stenciled as prescribed in § 179.105-8.

[Amdt. 179-19, 42 FR 46313, Sept. 15, 1977]

§ 179.105-3 Previously built cars.

(a) After December 31, 1978, each specification 112 and 114 tank car built before January 1, 1978, shall be equipped with a coupler restraint system that meets the requirements of § 179.105-6.

(b) Each tank car built before January 1, 1978, required to meet specification 112S and 114S, shall be equipped with a tank head puncture resistance system in accordance with the requirements of paragraph (d) of this section and § 179.105-5, and be stenciled as prescribed in § 179.105-8.

(c) Each tank car built before January 1, 1978, required to meet specification 112J, 112T, 114J, and 114T, shall:

(1) Be equipped with a thermal protective system that meets the requirements of § 179.105-4;

(2) Be equipped with a tank head puncture resistance system that meets the requirements of § 179.105-5;

(3) Be equipped with a safety relief valve that meets the requirements of § 179.105-7; and

(4) Comply with paragraph (d) of this section.

(5) Be stenciled as prescribed in § 179.105-8.

(d) Each tank car owner shall equip its tank cars which are subject to paragraphs (b) and (c) of this section in accordance with the following schedule:

(1) Each tank car which is being retrofitted in accordance with paragraph (b) of this section, shall be retrofitted not later than December 31, 1979.

(2) Each tank car which is being retrofitted in accordance with paragraph (c) of this section, with a nonjacketed thermal protective system and a separate tank head puncture resistance system (112T/114T) shall be retrofitted:

(i) With the tank head puncture resistance system not later than December 31, 1979; and

(ii) With thermal protection not later than December 31, 1980.

(3) All tank cars being retrofitted in accordance with paragraph (c) of this section, with a thermal protective system enclosed in a metal jacket (112J/114J) shall be retrofitted such that—

(i) At least 20 percent of those cars owned on December 31, 1978, are so equipped by not later than that date;

(ii) At least 65 percent of those cars owned on December 31, 1979, are so equipped by not later than that date; and

(iii) All of those cars owned on December 31, 1980, are so equipped by not later than that date.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 179-19, 42 FR 46313, Sept. 15, 1977, as amended by Amdt. 179-23, 43 FR 30061, July 13, 1978]

§ 179.105-4 Thermal protection.

(a) *Performance standard.* Each specification 112T, 112J, 114T, and 114J tank car shall be equipped with a thermal protection system that prevents the release of any of the car's contents (except release through the safety relief valve) when subjected to:

(1) A pool fire for 100 minutes; and

(2) A torch fire for 30 minutes.

(b) *Test verification.* Except as provided in paragraph (c) of this section, compliance with the requirements of paragraph (a) of this section shall be verified by testing and analyzing the thermal protection system in accordance with paragraphs (d), (e), and (f) of this section. A complete record of each test verification shall be made, retained and, upon request, made available for inspection and copying by authorized representatives of the Department.

(c) *Excepted systems.* The Department maintains a list of thermal protection systems which comply with the requirements of paragraphs (d) and (e) of this section and which are excepted from the test verification requirement of paragraph (b) of this section. Information necessary to equip tank cars with one of these systems is available in the Dockets Branch, Room 8426 of the Nassif Building, 400 Seventh Street SW., Washington, D.C. 20590, between the hours of 8:30 a.m.

and 5:00 p.m., Monday through Friday.

(d) *Simulated pool fire test.* (1) A pool fire environment shall be simulated in the following manner:

(i) The source of the simulated pool fire shall be a hydrocarbon fuel. The flame temperature from the simulated pool fire shall be at 1,600 F. plus-or-minus 100 F. throughout the duration of the test.

(ii) An uninsulated square steel plate with thermal properties equivalent to tank car steel shall be used. The plate dimensions shall be not less than one foot by one foot by nominal ⅝-inch thick. The plate shall be instrumented with not less than nine thermocouples to record the thermal response of the plate. The thermocouples shall be attached to the surface not exposed to the simulated pool fire, and shall be divided into nine equal squares with a thermocouple placed in the center of each square.

(iii) The pool fire simulator shall be constructed in a manner that results in total flame engulfment of the front surface of the bare plate. The apex of the flame shall be directed at the center of the plate.

(iv) The steel plate holder shall be constructed in such a manner that the only heat transfer to the back side of the plate is by heat conduction through the plate and not by other heat paths.

(v) Before the plate is exposed to the simulation pool fire, none of the temperature recording devices shall indicate the plate temperature in excess of 100 F. nor less than 32 F.

(vi) A minimum of two thermocouples devices shall indicate 800 F. after not less than 12 minutes nor more than 14 minutes of simulated pool fire exposure.

(2) A thermal insulation system shall be tested in the simulated pool fire environment described in paragraph (d)(1) of this section in the following manner:

(i) The thermal insulation system shall cover one side of a steel plate identical to that used to simulate a pool fire under paragraph (d)(1)(ii) of this section.

(ii) The uninsulated side of the steel plate shall be instrumented with not less than nine thermocouples placed as described in paragraph (d)(1)(ii) of this section to record the thermal response of the steel plate.

(iii) Before exposure to the pool fire simulation, none of the thermocouples on the thermal insulation system/steel plate configuration shall indicate a plate temperature in excess of 100 F. nor less than 32 F.

(iv) The entire insulated surface of the thermal insulation system shall be exposed to the simulated pool fire.

(v) A pool fire simulation test shall run for a minimum of 100 minutes. The thermal insulation system shall retard the heat flow to the steel plate so that none of the thermocouples on the uninsulated side of the steel plate indicates a plate temperature in excess of 800 F.

(vi) A minimum of three consecutive successful simulation fire tests shall be performed for each thermal insulation system.

(e) *Simulated torch fire test.* (1) A torch fire environment shall be simulated in the following manner:

(i) The source of the simulated torch shall be a hydrocarbon fuel. The flame temperature from the simulated torch shall be 2,200 F. plus-or-minus 100 F. throughout the duration of the test. Torch velocities shall be 40 miles per hour plus-or-minus 10 miles per hour throughout the duration of the test.

(ii) An uninsulated square steel plate with thermal properties equivalent to tank car steel shall be used. The plate dimensions shall be not less than four feet by four feet by nominal ⅝-inch thick. The plate shall be instrumented with not less than nine thermocouples to record the thermal response of the plate. The thermocouples shall be attached to the surface not exposed to the simulated torch, and shall be divided into nine equal squares with a thermocouple placed in the center of each square.

(iii) The steel-plate holder shall be constructed in such a manner that the only heat transfer to the back side of the plate is by heat conduction through the plate and not by other heat paths. The apex of the flame shall be directed at the center of the plate.

(iv) Before exposure to the simulated torch, none of the temperature recording devices shall indicate a plate temperature in excess of 100 F. or less than 32 F.

(v) A minimum of two thermocouples shall indicate 800 F. in a time of 4.0 plus-or-minus 0.5 minutes of torch simulation exposure.

(2) A thermal insulation system shall be tested in the simulated torch fire environment described in paragraph (e)(1) of this section in the following manner:

(i) The thermal insulation system shall cover one side of a steel plate identical to that used to simulate a torch fire under paragraph (e)(1)(ii) of this section.

(ii) The back of the steel plate shall be instrumented with not less than nine thermocouples placed as described in paragraph (e)(1)(ii) of this section to record the thermal response of the steel.

(iii) Before exposure to the simulated torch, none of the thermocouples on the thermal insulation system steel plate configuration shall indicate a plate temperature in excess of 100 F. nor less than 32 F.

(iv) The entire outside surface of the thermal insulation system shall be exposed to the simulated torch fire environment.

(v) A torch simulation test shall be run for a minimum of 30 minutes. The thermal insulation system shall retard the heat flow to the steel plate so that none of the thermocouples on the uninsulated side of the steel plate indicates a plate temperature in excess of 800 F.

(vi) A minimum of two consecutive successful torch simulation tests shall be performed for each thermal insulation system.

(f) *Analysis.* The analysis required by paragraph (b) of this section must verify that the entire surface of the tank car, including discontinuous structures (e.g., stub sills, protective housings, etc.), complies with the requirements of paragraph (a) of this section.

(g) *Exterior tank color.* Notwithstanding the provisions of § 179.101-1(a) Table, Note 4, each specification 112 and 114 tank car equipped with thermal protection that complies with the requirements of paragraph (a) of this section need not be painted white.

[Amdt. 179-19, 42 FR 46313, Sept. 15, 1977, as amended by Amdt. 179-27, 46 FR 8011, Jan. 26, 1981]

§ 179.105-5 Tank head puncture resistance.

(a) *Performance standard.* Each specification 112S, 112T, 112J, 114S, 114T, and 114J tank car shall be capable of sustaining, without loss of contents, coupler-to-tank head impacts within the area of the tank head described in § 179.100-23 at relative car speeds of 18 miles per hour when:

(1) The weight of the impact car is at least 263,000 pounds;

(2) The impacted tank car is coupled to one or more "backup" cars which have a total weight of at least 480,000 pounds and the hand brakes are applied on the first car; and

(3) The impacted tank car is pressurized to at least 100 psi.

(b) *Test verification.* Compliance with the requirements of paragraph (a) of this section shall be verified by full scale testing or by the alternate test procedures prescribed in paragraph (c) of this section. However, protective head shields that meet the requirements of § 179.100-23 or full tank head jackets that are at least ½-inch thick and made from steels specified in § 179.100-23(a)(1) need not be verified by testing.

(c) *Tank head puncture resistance test.* A tank head resistance system shall be tested under the following conditions:

(1) The ram car used shall weigh at least 263,000 pounds, be equipped with a coupler, and duplicate the condition of a conventional draft sill including the draft yoke and draft gear. The coupler shall protrude from the end of the ram car so that it is the leading location of perpendicular contact with the standing tank car.

(2) The impacted test car shall be loaded with water at six percent outage with internal pressure of at least 100 psi and coupled to one or more "backup" cars which have a total weight of 480,000 pounds with hand brakes applied on the first car.

(3) At least two separate tests shall be conducted with the coupler on the vertical centerline of the ram car. One test shall be conducted with the coupler at a height of 21 inches, plus-or-minus one-inch, above the top of the sill; the other test shall be conducted with the coupler height at 31 inches, plus-or-minus one-inch above the top of the sill. If the combined thickness of the tank head and any additional shielding material at any position over the area described in § 179.100-23 is less than the combined thickness on the vertical centerline of the car, a third test shall be conducted with the coupler positioned so as to strike the thinnest point.

(4) One of the following test procedures shall be applied:

	Minimum velocity of impact (in miles per hour)	Restriction
Minimum weight of ram car plus attached cars (in pounds):		
263,000	18	1 ram car only.
343,000	16	1 ram car or 1 ram car plus 1 rigidly attached car.
686,000	14	1 ram car plus 1 or more rigidly attached cars.

(5) A test is successful if there is no visible leak from the standing tank car within one hour after impact.

[Amdt. 179-19, 42 FR 46314, Sept. 15, 1977]

§ 179.105-6 Coupler vertical restraint system.

(a) *Performance standard.* Each specification 112 and 114 tank car shall be equipped with couplers capable of sustaining, without disengagement or material failure, vertical loads of at least 200,000 pounds applied in upward and downward directions in combination with buff loads of 2,000 pounds, when coupled to cars equipped with couplers that do have this vertical restraint capability, and cars equipped with couplers that do not have this vertical restraint capability.

(b) *Test verification and approval.* Except as provided in paragraph (d) of this section, compliance with the requirements of paragraph (a) of this section shall be achieved by verification testing of the coupler vertical restraint system in accordance with paragraph (c) of this section, and approval of the Federal Railroad Administrator.

(c) *Coupler vertical restraint tests.* A coupler vertical restraint system shall be tested under the following conditions:

(1) The test coupler shall be tested with: A mating coupler (or simulated coupler) having only frictional vertical force resistance at the mating interface; a mating coupler (or simulated coupler) having the capabilities described in paragraph (a) of this section.

(2) The testing apparatus shall simulate the vertical coupler performance at the mating interface and may not interfere with coupler failure or otherwise inhibit failure due to force applications and reactions.

(3) The test shall be conducted as follows: (i) A minimum of 200,000 pounds vertical downward load shall be applied continuously for at least five minutes to the test coupler head simultaneously with the application of a nominal 2,000-pound buff load;

(ii) The procedures prescribed in paragraph (c)(3)(i) of this section shall be repeated with a minimum vertical upward load of 200,000 pounds;

(iii) A minimum of three consecutive successful tests shall be performed for each load combination prescribed in paragraphs (c)(3) (i) and (ii) of this section. A test is successful when a vertical disengagement or material failure does not occur during any of the prescribed load combinations.

(d) *Listing of approved couplers.* The following classes of couplers have been approved by the Federal Railroad Administrator and need not be verified by the testing requirements of paragraph (c) of this section:

(1) E top and bottom shelf couplers designated by the Association of American Railroads' Catalog Nos. SE60CHT, SE60CHTE, SE67BHT, SE67BHTE, SE68BHT or SE68BHTE; or

(2) F top shelf couplers designated by the Association of American Railroads Catalog Nos. SF70CHT, SF70CHTE, SF73AHT, SF73AHTE, SF79CHT or SF79CHTE.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 179-19, 42 FR 46315, Sept. 15, 1977, as amended by Amdt. 179-21, 43 FR 7437, Feb. 23, 1978]

§ 179.105-7 Safety relief valves.

(a) Notwithstanding the provisions of § 179.105-4, each 112 and 114 tank car shall be equipped with safety relief valves that meet the requirements of Appendix A of the AAR Specifications for Tank Cars. However, the relieving or discharge capacity shall be calculated in accordance with the formula prescribed in section A8.02 of Appendix A applicable to compressed gases in non-insulated tanks.

(b) The references in paragraph (a) of this section to Appendix A of the AAR Specifications for Tank Cars are to the 1976 edition of that publication.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 179-19, 43 FR 2181, Jan. 16, 1978]

§ 179.105-8 Stenciling.

(a) Each 112 and 114 tank car that is equipped with a tank puncture resistance system as specified in § 179.105-5 shall have the letter "S" substituted for the "A" in the specification marking.

(b) Each 112 and 114 tank car that is equipped with a thermal protection system enclosed in a metal jacket shall have the letter "J" substituted for the "A" and "S" in the specification marking.

(c) Each 112 and 114 tank car that is equipped with a non-jacketed thermal protection system shall have the letter "T" substituted for the "A" and "S" in the specification marking.

[Amdt. 179-19, 42 FR 46315, Sept. 15, 1977]

§ 179.105-9 Compliance reporting.

(a) By October 16, 1978, each tank car owner shall report in writing to the Associate Administrator for Safety, FRA (Attention: RRS-25), the following information concerning specifications 112 and 114 pressure tank cars bearing the owner's reporting mark:

(1) The total number of such cars and a list of applicable reporting marks (by consecutive series, where appropriate);

(2) A declaration of intent concerning the number of cars scheduled to be equipped to each of the respective specifications subject to this section (i.e., 112A/114A, 112S/114S, 112T/114T, 112J/114J) and the disposition of any remaining 112/114 cars; and

(3) A description of steps being taken to comply with § 179.105-3 (previously built cars), including—

(i) The number of cars scheduled to be equipped to specifications 112S/114S and 112T/114T, respectively, which have been equipped with a tank head puncture resistance system meeting the requirements of § 179.105-5, and remain to be equipped with a tank head puncture resistance system;

(ii) The number of cars scheduled to be equipped to specification 112T/114T which have been equipped with a thermal protection system that meets the requirements of § 179.105-4, and remain to be equipped with a thermal protection system;

(iii) The number of cars scheduled to be equipped to specification 112J/114J which have been equipped with the thermal protection system and tank head protection system required by §§ 179.105-4 and 179.105-5, and remain to be equipped to specification 112J/114J; and

(iv) The number of cars which have been equipped with a coupler restraint system meeting the requirements of § 179.105-6, and remain to be equipped with such a system.

(b) By the last day of the calendar month following the end of each quarter, each tank car owner shall submit to the Associate Administrator for Safety, Federal Railroad Administration (Attention: RRS-25), a written progress report updating the information required to be submitted by paragraphs (a) (2) and (3) of this section. The first report shall be submitted by January 31, 1979.

(c) When a tank car owner has equipped all 112 and 114 cars built prior to January 1, 1978 with the devices required by § 179.105 for the type of service in which the cars are to be utilized, the tank car owner shall certify in a final compliance report to the Associate Administrator for Safety, Federal Railroad Administration (Attention: RRS-25), that all 112 and 114 tank cars are properly equipped. Following the submission of that certificate, no further reports shall be required under paragraph (b) of this section, unless the tank car owner subsequently acquires additional cars requiring the application of devices required by § 179.105.

(d) Each tank car owner, including any person attaining to that status at any time prior to December 31, 1980, shall include in the quarterly report required by paragraph (b) of this section a listing by reporting mark of all 112 and 114 tank cars acquired, transferred, or destroyed during the quarter, specifying the action taken with respect to each car. In the case of cars newly acquired, the quarterly report shall also provide the information required by paragraph (a) (2) and (3) of this section.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 179-24, 43 FR 39793, Sept. 7, 1978]

§ 179.106 Special requirements for Specification 105 tank cars.

[Amdt. 179-27, 46 FR 8012, Jan. 26, 1981]

§ 179.106-1 General.

(a) In addition to the requirements of this section, each tank car built under Specification 105 shall meet the applicable requirements of §§ 179.100, 179.101, 179.102 and 179.104.

(b) Notwithstanding the provisions of §§ 179.3, 179.4, and 179.6, AAR approval is not required for changes in or additions to Specification 105 tank cars in order to comply with this section.

(c) Notwithstanding the provisions of § 173.8 of this subchapter, no Specification 105 tank car manufactured to specifications promulgated by the Canadian Transport Commission may be used after February 28, 1982, to transport hazardous materials in the United States unless it is equipped with a coupler vertical restraint system that meets the requirements of § 179.105-6.

(d) Notwithstanding the provisions of § 173.8 of this subchapter, no Specification 105 tank car manufactured after August 31, 1981, to specifications promulgated by the Canadian Transport Commission, may be used to transport hazardous materials in the United States unless it is equipped in accordance with§ 179.106-2.

[Amdt. 179-27, 46 FR 8012, Jan. 26, 1981]

§ 179.106-2 New cars.

(a) Each Specification 105A tank car built after February 28, 1981, shall be equipped with a coupler restraint system that meets the requirements of § 179.105-6.

(b) Each Specification 105S tank car built after August 31, 1981, shall be equipped with:

(1) A coupler restraint system that meets the requirements of § 179.105-6; and

(2) A tank head puncture resistance system that meets the requirements of § 179.105-5.

(c) Each Specification 105J tank car built after August 31, 1981, shall be equipped with:

(1) A coupler restraint system that meets the requirements of § 179.105-6;

(2) A tank head puncture resistance system that meets the requirements of § 179.105-5;

(3) A thermal protection system that meets the requirements of § 179.105-4; and

(4) A safety relief valve that meets the requirements of § 179.105-7.

(d) Each Specification 105 tank car shall be stenciled as prescribed in § 179.106-4.

[Amdt. 179-27, 46 FR 8012, Jan. 26, 1981]

§ 179.106-3 Previously built cars.

After February 28, 1982, each Specification 105 tank car built before March 1, 1981, shall be equipped with a coupler restraint system that meets the requirements of § 179.105-6.

[Amdt. 179-27, 46 FR 8012, Jan. 26, 1981]

§ 179.106-4 Stenciling.

(a) Each Specification 105 tank car that is equipped with a coupler restraint system that meets the requirements of § 179.105-6 and a tank head puncture resistance system that meets the requirements of § 179.105-5 shall be stenciled by having the letter "S" substituted for the letter "A" in the specification marking.

(b) Each Specification 105 tank car that is equipped with a coupler restraint system that meets the requirements of § 179.105-6, a tank head puncture resistance system that meets the requirements of § 179.105-5, a thermal protection system that meets the requirements of § 179.105-6, and a safety relief valve that meets the requirements of § 179.105-7, shall be stenciled by having the letter "J" substituted for the letter "A" in the specification marking.

[Amdt. 179-27, 46 FR 8012, Jan. 26, 1981]

Subpart D—Specifications for Non-Pressure Tank Car Tanks (Classes DOT-103, 104, 111AF, 111AW, and 115AW)

§ 179.200 General specifications applicable to non-pressure tank car tanks (Classes DOT-103, 104, and 111).

[Amdt. 179-10, 36 FR 21348, Nov. 6, 1971]

§ 179.200-1 Tank built under these specifications must meet the requirements of §§ 179.200, 179.201 and when applicable § 179.202.

[Amdt. 179-10, 36 FR 21348, Nov. 6, 1971]

§ 179.200-2 Approval.

(a) For procedure for securing approval, see § 179.3.

§ 179.200-3 Type.

Tank built under these specifications must be circular in cross section, with formed heads designed convex outward. When specified in § 179.201-1, the tank must have at least one manway or one expansion dome with manway, and such other external projections as are prescribed herein. When the tank is divided into compartments, each compartment must be treated as a separate tank.

[Amdt. 179-10, 36 FR 21348, Nov. 6, 1971]

§ 179.200-4 Insulation.

(a) If insulation is applied, the tank shell and expansion dome when used must be insulated with an approved material. The entire insulation must be covered with a metal jacket of a thickness not less than 11 gauge (0.1196 inch) nominal (Manufacturer's Standard Gauge) and flashed around all openings so as to be weather tight. The exterior surface of a carbon steel tank and the inside surface of a carbon steel jacket must be given a protection coating, except that protective coating is not required when foam-in-place insulation that adheres to the tank or jacket is applied.

(b) If insulation is a specification requirement, it shall be of sufficient thickness so that the thermal conductance at 60 F is not more than 0.225 Btu per hour, per square foot, per degree F temperature differential, unless otherwise provided in § 179.201-1. If exterior heaters are attached to tank, the thickness of the insulation over each heater element may be reduced to one-half that required for the shell.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21349, Nov. 6, 1971]

§ 179.200-5 Bursting pressure.

(a) The minimum required bursting pressure is listed in § 179.201-1.

§ 179.200-6 Thickness of plates.

(a) The wall thickness after forming of the tank shell, dome shell, and of 2:1 ellipsoidal heads must be not less than specified in § 179.201-1, nor that calculated by the following formula:

$$t = Pd/2SE$$

where:

d = Inside diameter in inches;

E = 0.9 Welded joint efficiency; except $E = 1.0$ for seamless heads;

P = Minimum required bursting pressure in p.s.i.;

S = Minimum tensile strength of plate material in p.s.i. as prescribed in § 179.200-7;

t = Minimum thickness of plate in inches after forming.

(b) The wall thickness after forming of 3:1 ellipsoidal heads must be not less than specified in § 179.201-1, nor that calculated by the following formula:

$$t = Pd/2SE \times 1.83$$

where:

d = Inside diameter in inches;
E = 0.9 Welded joint efficiency; except E = 1.0 for seamless heads;
P = Minimum required bursting pressure in p.s.i.;
S = Minimum tensile strength of plate material in p.s.i. as prescribed in § 179.200-7;
t = Minimum thickness of plate in inches after forming.

(c) The wall thickness after forming of a flanged and dished head must be not less than specified in § 179.201-1, nor that calculated by the following formula:

$$t = 5PL/6SE$$

where:

E = 0.9 Welded joint efficiency; except E = 1.0 for seamless heads;
L = Main inside radius to which head is dished, measured on concave side in inches;
P = Minimum required bursting pressure in p.s.i.;
S = Minimum tensile strength of plate material in p.s.i. as prescribed in § 179.200-7;
t = Minimum thickness of plate in inches after forming.

(d) If plates are clad with material having tensile strength properties at least equal to the base plate, the cladding may be considered a part of the base plate when determining thickness. If cladding material does not have tensile strength at least equal to the base plate, the base plate alone must meet the thickness requirements.

(e) For a tank constructed of longitudinal sections, the minimum width of bottom sheet of the tank must be 60 inches measured on the arc, but in all cases the width must be sufficient to bring the entire width of the longitudinal welded joint, including welds, above the bolster.

(f) For a tank built of one piece cylindrical sections, the thickness specified for bottom sheet must apply to the entire cylindrical section.

(g) See § 179.200-9 for thickness requirements for a compartmented tank.

[Amdt. 179-10, 36 FR 21349, Nov. 6, 1971]

§ 179.200-7 Materials.

(a) Plate material used to fabricate the tank and, when used, expansion dome or manway nozzle material, must meet one of the following specifications with the indicated minimum tensile strength and elongation in the welded condition.

(b) *Carbon steel plate:* The maximum allowable carbon content must be 0.31 percent when the individual specification allows carbon content greater than this amount. The plates may be clad with other approved materials:

Specifications	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM A 515-70, Gr. 55	55,000	28
ASTM A 515-70, Gr. 60	60,000	25
ASTM A 515-70, Gr. 65	65,000	20
ASTM A 515-70, Gr. 70	70,000	20
ASTM A 285-70a, Gr. A	45,000	29
ASTM A 285-70a, Gr. B	50,000	20
ASTM A 285-70a, Gr. C	55,000	20
ASTM A 516-70a, Gr. 55	55,000	28
ASTM A 516-70a, Gr. 60	60,000	25
ASTM A 516-70a, Gr. 65	65,000	20
ASTM A 516-70a, Gr. 70	70,000	20
AAR TC128-70, Gr. A and B	81,000	19

[1] Maximum stresses to be used in calculations.

(c) *Aluminum alloy plate:* Aluminum alloy plate must be suitable for welding and comply with one of the following specifications:

Specifications	Minimum tensile strength (p.s.i.) 0 temper welded condition [3] [6]	Minimum elongation in 2 inches (percent) 0 temper welded condition (longitudinal)
ASTM B 209-70, Alloy 5052 [1]	25,000	18
ASTM B 209-70, Alloy 5083 [2]	38,000	16
ASTM B 209-70, Alloy 5086 [1]	35,000	14
ASTM B 209-70, Alloy 5154 [1]	30,000	18
ASTM B 209-70, Alloy 5254 [1]	30,000	18
ASTM B 209-70, Alloy 5454 [1]	31,000	18
ASTM B 209-70, Alloy 5652 [1]	25,000	18
ASTM B 209-70, Alloy 6061 [4]	[5] 24,000	[5] 5

[1] For fabrication, the parent plate material may be 0, H112, or H32 temper, but design calculations must be based on minimum tensile strength shown.

[2] 0 temper only.

[3] Weld filler metal 5556 must not be used.

[4] Not authorized for tank shells, manways or domes.

[5] 6 temper only.

[6] Maximum stresses to be used in calculations.

(d) *High alloy steel plate:* High alloy steel plate must comply with one of the following specifications:

Specifications [2]	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM A 240-70, Type 304	75,000	30
ASTM A 240-70, Type 304L	70,000	30
ASTM A 240-70, Type 316	75,000	30
ASTM A 240-70, Type 316L	70,000	30
ASTM A 240-70, Type 430A	65,000	22

[1] Maximum stresses to be used in calculations.

[2] High alloy steel materials used to fabricate tank and expansion dome, when used, must be tested in accordance with the following procedures in ASTM Specification A 262-68 titled, "Recommended Practices for Detecting Susceptibility to Intergranular Attack in Stainless Steels," and must exhibit corrosion rates not exceeding the following:

Test procedure	Material	Corrosion rate i.p.m.
Practice B	Types 304, 304L, 316, and 316L.	0.0040
Practice C	Type 304L	.0020
Do	Type 430A	.0060

Type 304L and Type 316L test specimens must be given a sensitizing treatment prior to testing. (A typical sensitizing treatment is 1 hour at 1250 F.)

(e) *Nickel plate:* Nickel plate must comply with the following specification:

Specifications	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM B 162-69 [2]	40,000	20

[1] Maximum stresses to be used in calculations.

[2] When used as cladding for carbon steel plate, low-carbon nickel is required.

(f) *Manganese-molybdenum steel plate:* Manganese-molybdenum steel plate must be suitable for fusion welding and comply with the following specification:

Specifications	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM A 302-69a, Gr. B	80,000	20

[1] Maximum stresses to be used in calculations.

(g) All parts and items of construction in contact with the lading must be made of material compatible with plate material and not subject to rapid deterioration by the lading, or be coated or lined with suitable corrosion resistant material.

(h) All external projections which may be in contact with the lading and all castings, forgings, or fabrications used for fittings or attachments to tank and expansion dome, when used, in contact with lading must be made of material to an approved specification. See AAR Specification for Tank Cars, Appendix M, M4.05 for approved material specifications for castings for fittings.

[Amdt. 179-10, 36 FR 21349, Nov. 9, 1971; 36 FR 21893, Nov. 17, 1971]

§ 179.200-8 Tank heads.

(a) All external tank heads must be an ellipsoid of revolution in which the major axis must equal the diameter of the shell and the minor axis must be one-half the major axis.

(b) Internal compartment tank heads may be 2:1 ellipsoidal, 3:1 ellipsoidal, or flanged and dished to thicknesses as specified in § 179.200-6. Flanged and dished heads must have main inside radius not exceeding 10 feet, and inside knuckle radius must not be less than 3¾ inches for steel, alloy steel, or nickel tanks, and not less than 5 inches for aluminum alloy tanks.

[Amdt. 179-10, 36 FR 21350, Nov. 6, 1971]

§ 179.200-9 Compartment tanks.

(a) When a tank is divided into compartments, by inserting interior heads, interior heads must be inserted in accordance with AAR Specifications for Tank Cars, Appendix E, E7.00, and must comply with the requirements specified in § 179.2011-1. Voids between compartment heads must be provided with at least one tapped drain hole at their lowest point, and a tapped hole at the top of the tank. Top hole must be closed, and the bottom hole may be closed, with not less than three-fourths inch nor more than 1½-inches solid pipe plugs having NPT threads.

(b) When the tank is divided into compartments by construction each compartment as a separate tank, these tanks shall be joined together by a cylinder made of plate, having a thickness not less than that required for the tank shell and applied to the outside surface of tank head flanges. The cylinder shall fit the straight flange portion of the compartment tank head tightly. The cylinder shall contact the head flange for a distance of at least two times the plate thickness, or a minimum of 1 inch, whichever is greater. The cylinder shall be joined to the head flange by a full fillet weld. Distance from head seam to cylinder shall not be less than 1½ inches or three times the plate thickness, whichever is greater. Voids created by the space between heads of tanks joined together to form a compartment tank shall be provided with a tapped drain hole at their lowest point and a tapped hole at top of tank. The top hole shall be closed and the bottom hole may be closed with solid pipe plugs not less than ¾ inch nor more than 1½ inches having NPT threads.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21350, Nov. 6, 1971]

§ 179.200-10 Welding.

(a) All joints shall be fusion-welded in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W. Welding procedures, welders and fabricators shall be approved.

(b) Welding is not permitted on or to ductile iron or malleable iron fittings.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21350, Nov. 6, 1971]

§ 179.200-11 Postweld heat treatment.

After welding is complete, postweld heat treatment must be in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W, when specified in § 179.201.1.

[Amdt. 179-10, 36 FR 21350, Nov. 6, 1971]

§ 179.200-12 Tank mounting. See § 179.10.

§ 179.200-13 Manway ring or flange, safety relief device flange, bottom outlet nozzle flange, bottom washout nozzle flange and other attachments and openings.

(a) For steel and aluminum tanks, these attachments shall be riveted or fusion-welded.

(b) For alloy steel and nickel tanks these attachments shall be fusion-welded.

(c) Fusion-welding for securing these attachments in place shall be of the double-welded butt joint type or double full-fillet lap joint type.

(d) Rivets, if used, must comply with AAR Specification M-110-64 or its equivalent, must be compatible with plate material, and must meet the following additional requirements:

(1) Riveted joints shall be made metal to metal without interposition of other material.

(2) Rivets shall be driven hot and calked inside. All joints formed by all riveted attachments shall be caulked inside. Split calking is prohibited.

(3) Use of rivets less than ⅝ inch nominal diameter prohibited.

(4) For computing rivet areas the effective diameter of a driven rivet is the diameter of its reamed hole, which hole shall in no case exceed nominal diameter of rivet by more than ¹⁄₁₆ inch.

(5) When attachments are applied by means of riveting, the edges of plates shall be beveled so that the angle of the caulking edge will be between 60 and 70 degrees with the flat surface of the attachment. The extreme caulking edge distance, measured from center line of rivet hole, shall be at least one and one-half times the diameter of the hole and not more than that distance plus ¼ inch.

(6) Rivets shall be handled and driven in a manner that will insure requisite strength.

(e) The opening in the manway ring shall be at least 16 inches in diameter except that acid resistant lined manways shall be at least 18 inches in diameter before lining.

(f) Manway ring or flange, if riveted to dome or tank, shall be of cast, forged or fabricated steel, malleable iron or other malleable metals.

(g) Manway ring or flange, if welded to dome, tank or nozzle, shall be made of cast, forged or fabricated metal and be of good weldable quality in conjunction with metal of dome, tank, or nozzle.

(h) Openings for manway or other fittings shall be reinforced in an approved manner.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21350, Nov. 6, 1971]

§ 179.200-14 Expansion capacity.

(a) Tanks shall have expansion capacity as prescribed in § 179.201-1. This capacity shall be provided in the tank for Class DOT-111A cars, or in a dome for Class DOT-103 and 104 type cars.

(b) The capacity of the expansion dome, when used, shall be at least the percentage specified in § 179.201-1 of the total capacity of the tank and dome combined. The capacity of the dome shall be measured from the inside top of shell of tank to the inside top of dome or bottom of any vent pipe projecting inside of dome, except that when safety relief device is applied to side of dome, the effective capacity of the dome shall be measured from top of safety relief device opening inside of dome to inside top of shell of tank.

(c) The opening in the tank shell within the dome shall be at least 29 inches in diameter. When the opening in the tank shell exceeds 30 inches in diameter, the opening shall be reinforced in an approved manner. When the opening in the tank shell is less than the inside diameter of the dome, and the dome pocket is not closed off in an approved manner, dome pocket drain holes shall be provided in the tank shell with nipples projecting inside the tank at least 1 inch.

(d) The dome head shall be of approved contour and shall be designed for pressure on concave side.

(e) Aluminum alloy domes: (1) The dome shell thickness shall be calculated by the formula in § 179.200-6(a).

(2) The dome head may be an ellipsoid of revolution in which the major axis shall be equal to the diameter of the dome shall and the minor axis shall be one-half the major axis. The thickness in this case shall be determined by using formula in § 179.200-6(a).

(3) The dome head, if dished, must be dished to a radius not exceeding 96 inches. Thickness of dished dome head must be calculated by the formula in § 179.200-6(c).

(4) Tank shell shall be reinforced by the addition of a plate equal to or greater than shell in thickness and the cross sectional area shall exceed metal removed for dome opening, or tank shell shall be reinforced by a seamless saddle plate equal to or greater than shell in thickness and butt welded to tank shell. The reinforcing saddle plate shall be provided with a fluid opening having a vertical flange of the diameter of the dome for butt welding shell of dome to the flange. The reinforcing saddle plate shall extend about the dome a distance measured along shell of tank at least equal to the extension at top of tank. Other approved designs may be used.

(f) For thickness of carbon or alloy steel domes, see § 179.201-2.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21350, Nov. 6, 1971]

§ 179.200-15 Closures for manways.

(a) Manway covers shall be of approved type. See § 179.202-1 for special requirements for flammable liquids.

(b) Manway covers shall be designed to provide a secure closure of the manway.

(c) Manway covers must be of approved cast, forged, or fabricated metals. Malleable iron, if used, must comply with ASTM A47-68, Grade 35018. Cast iron manway covers must not be used.

(d) All joints between manway covers and their seats shall be made tight against leakage of vapor and liquid by use of gaskets of suitable material.

(e) For other manway cover requirements see § 179.201-1.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21350, Nov. 6, 1971]

§ 179.200-16 Gauging devices, top loading and unloading devices, venting and air inlet devices.

(a) When installed, these devices shall be of an approved design which will prevent interchange with any other fixture, and be tightly closed. Unloading pipes shall be securely anchored within the tank. Each tank or compartment may be equipped with one separate air connection.

(b) When the characteristics of the commodity for which the car is authorized are such that these devices must be equipped with valves or fittings to permit the loading and unloading of the contents, these devices, including valves, shall be of an approved design, and be provided with a protective housing except when plug or ball type valves with operating handles removed are used. Provision shall be made for closing pipe connections of valves.

(c) A tank may be equipped with a vacuum relief valve of an approved design. Protective housing is not required.

(d) When gaging device is required in § 179.201-1, an outage scale visible through manway opening shall be provided. If loading devices are applied to permit tank loading with cover closed, a telltale pipe may be provided. Telltale pipe shall be capable of determining that required outage is provided. Pipe shall be equipped with ¼ inch minimum NPT control valve mounted outside tank and enclosed within a housing. Other approved devices may be used in lieu of outage scale or telltale pipe.

(e) Bottom of tank shell may be equipped with a sump or siphon bowl, or both, welded or pressed into the shell. Such sumps or siphon bowls, if applied are not limited in size and must be made of cast, forged, or fabricated metal. Each sump or siphon bowl must be of good welding quality in conjunction with the metal of the tank shell. When sump or siphon bowl is pressed in the bottom of the tank shell, the wall thickness of the pressed section must not be less than that specified for the shell. The section of a circular cross section tank to which a sump or siphon bowl is attached need not comply with the out-of-roundness requirement specified in Appendix W, W14.06, of the AAR Specifications for Tank Cars. Any portion of a sump or siphon bowl not forming a part of a cylinder of revolution must have walls of such thickness and be so reinforced that the stresses in the walls caused by a given internal pressure are not greater than the circumferential stress which would exist under the same internal pressure in the wall of a tank of circular cross section designed in accordance with § 179.200-6 (a) and (d). In no case shall the wall thickness be less than that specified in § 179.201-1(a).

(f) When top loading and discharge devices, or venting and air inlet devices are installed with exposed piping to a removed location, shutoff valves must be applied directly to reinforcing pads or nozzles at their communication through the tank shell, and must be enclosed in a protective housing with provision for a seal. The piping must include breakage grooves, and suitable bracing. Relief valves must be applied to liquid lines for protection in case lading is trapped. Provision must be made to insure closure of the valves while the car is in transit.

(g) Protective housing, when required, must be fabricated of approved material and have cover and sidewalls not less than 0.119 inch in thickness.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21350, Nov. 6, 1971]

§ 179.200-17 Bottom outlets.

(a) If indicated in § 179.201-1, tank may be equipped with bottom outlet. Bottom outlet, if applied, must comply with the following requirements:

(1) On newly built empty cars with truck centers through 60 feet, 6 inches, the extreme projection of the bottom outlet equipment must be at least 12 inches above the top of rail on level track. On cars with truck centers greater than 60 feet, 6 inches, the minimum rail clearance must be in ac-

cordance with the graph in Appendix E of the AAR Specifications for Tank Cars. All bottom outlet reducers and closures and their attachments must be secured to car by at least ⅜-inch chain or its equivalent, except that outlet closure plugs may be attached by ¼-inch chain. When the bottom outlet closure is of the combination cap and valve type, the pipe connection to the valve must be closed by a plug, cap, or approved quick coupling device.

(2) Bottom outlet must be of approved construction, and be provided with a liquid-tight closure at its lower end.

(3) On cars with center sills, a ball valve may be welded to the outside bottom of the tank or mounted on a pad or nozzle with a tongue and groove or male and female flange attachment. In no case shall the breakage groove or equivalent extend below the bottom flange of the center sill. On cars without continuous center sills, a ball valve may be welded to the outside bottom of the tank or mounted with a tongue and groove or male and female flange attachment on a pad attached to the outside bottom of the tank. The mounting pad must have a maximum thickness of 2½ inches measured on the longitudinal centerline of the tank. The valve operating mechanism must be provided with a suitable locking arrangement to insure positive closure during transit.

(4) The valve operating mechanism for valves applied to the interior of the tank, and outlet nozzle construction, must insure against the unseating of the valve due to stresses or shocks incident to transportation.

(5) Bottom outlet nozzle of interior valves and the valve body of exterior valves, must be of cast, fabricated, or forged metal. If welded to tank, they must be of good weldable quality in conjunction with metal of tank.

(6) To provide for the attachment of unloading connections, the bottom of the main portion of the outlet nozzle or valve body of exterior valves, or some fixed attachment thereto, must be provided with threaded cap closure arrangement or bolted flange closure arrangement having minimum 1-inch threaded pipe plug or approved quick-coupling device. When two piece quick-coupling devices (i.e., adapter and dust cap) are used on bottom outlet extensions, an inline auxiliary valve must be applied between the bottom outlet valve and the quick-coupling closure. The quick-coupling closure (dust cap) or outlet nozzle wall must be fitted with a minimum 1-inch threaded plug. The auxiliary valve and dust cap may be omitted when the quick-coupling adapter is threaded internally and fitted with a minimum 1-inch plug.

(7) If outlet nozzle extends 6 inches or more from shell of tank, a "V" groove must be cut (not cast) in the upper part of outlet nozzle at a point immediately below lowest part of valve to a depth that will leave thickness of nozzle wall at the root of the "V" not over one-fourth of an inch. The outlet nozzle on interior valves or the valve body on exterior valves may be steam jacketed, in which case the breakage groove or its equivalent must be below the steam chamber but above the bottom of center sill construction. If outlet nozzle is not a single piece, or if exterior valves are applied, provision must be made for the equivalent of the breakage groove. On cars without continuous center sills, the breakage groove or its equivalent must be not more than 15 inches below the tank shell. On cars with continuous center sills the breakage groove or its equivalent must be above the bottom of the center sill construction.

(8) The flange on the outlet nozzle or the valve body of exterior valves must be of a thickness which will prevent distortion of the valve seat or valve by any change in contour of the shell resulting from expansion of lading, or other causes, and which will insure that accidental breakage of the outlet nozzle will occur at or below the "V" groove, or its equivalent.

(9) The valve must have no wings or stem projecting below the "V" groove or its equivalent. The valve and seat must be readily accessible or removable for repairs, including grinding.

(10) The valve operating mechanism on interior valves must have means for compensating for variation in the vertical diameter of the tank produced by expansion, weight of the liquid con-

tents, or other causes, and may operate from the interior of the tank, but in the event the rod is carried through the dome, or tank shell, leakage must be prevented by packing in stuffing box or other suitable seals and a cap.

(b) If indicated in § 179.201-1, tank may be equipped with bottom washout of approved construction. If applied, bottom washout shall be in accordance with the following requirements:

(1) On newly built empty cars with truck centers through 60 feet, 6 inches, the extreme projection of the bottom washout equipment must be at least 12 inches above the top of rail on level track. On cars with truck centers greater than 60 feet, 6 inches, the minimum rail clearance must be in accordance with the graph in Appendix E of the AAR Specifications for Tank Cars.

(2) Bottom washout shall be of cast, forged or fabricated metal. If welded to tank, they shall be of good weldable quality in conjunction with metal of tank.

(3) If washout nozzle extends 6 inches or more from shell of tank, a "V" groove must be cut (not cast) in the upper part of the nozzle at a point immediately below the lowest part of inside closure seat or plug to a depth that will leave wall thickness of nozzle at the root of the "V" not over one-fourth inch. Where nozzle is not a single piece, provision must be made for the equivalent of the breakage groove. The nozzle must be of a thickness to insure that accidental breakage will occur at or below the "V" groove or its equivalent. On cars without continuous center sills, the breakage groove or its equivalent must not be more than 15 inches below the tank shell. On cars with continuous center sills the breakage groove or its equivalent must be above the bottom of the center sill construction.

(4) The closure plug and seat must be readily accessible or removable for repairs, including grinding.

(5) The closure of the washout nozzle must be equipped with a ¾-inch solid screw plug. Plug must be attached by at least a ¼-inch chain.

(6) Joints between closures and their seats may be gasketed with suitable material.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21351, Nov. 6, 1971]

§ 179.200-18 Safety relief devices.

(a) Safety relief valves. (1) When permitted in § 179.201-1, each tank or compartment shall be equipped with one or more safety relief valves of approved design, made of metal not subject to rapid deterioration by the lading, and mounted on expansion dome of Class DOT-103 or 104 cars or top of tank shell of Class DOT-111A cars. Total valve discharge capacity shall be sufficient to prevent building up of pressure in the tank to more than 10 psi above start-to-discharge pressure. See AAR Specifications for Tank Cars, Appendix A, for formula for calculating discharge capacity.

(2) The start-to-discharge pressures and vapor tight pressures shall comply with § 179.201-1.

(b) Safety vents: (1) When permitted in § 179.201-1, each tank or compartment used for the transportation of corrosive liquids, flammable solids, oxidizing materials, or poisonous liquids or solids, Class B, need not be equipped with safety relief valves, but if not so equipped shall have one safety vent at least 1¾ inches inside diameter, of an approved design which will prevent interchange with fixtures prescribed in § 179.200-16(a), and closed with a frangible disc of lead or other approved material of a thickness that will rupture at not more than 100 percent of tank test pressure. Means for holding disc in place shall be such as to prevent distortion or damage to disc when applied. Safety vent closure shall be chained or otherwise fastened to prevent misplacement. All tanks equipped with vents shall be stenciled "Not for Flammable Liquids."

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-22, 43 FR 8523, Mar. 2, 1978]

§ 179.200-19 Reinforcements, when used, and appurtenances not otherwise specified.

(a) All attachments to tank and dome shall be applied by approved means. Rivets if used shall be caulked inside and outside.

(b) Reinforcing pads must be used between external brackets and shells if the attachment welds exceed 6 lineal inches of ¼-inch fillet or equivalent weld per bracket or bracket leg. When reinforcing pads are used, they must not be less than one-fourth inch in thickness, have each corner rounded to a 1 inch minimum radius, and be attached to the tank by continuous fillet welds except for venting provisions. The ultimate shear strength of the bracket to reinforcing pad weld must not exceed 85 percent of the ultimate shear strength of the reinforcing pad to tank weld.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21351, Nov. 6, 1971]

§ 179.200-20 Interior heater systems.

(a) See § 179.12.

§ 179.200-21 Closures for openings.

(a) All plugs shall be solid, with NPT threads, and shall be of a length which will screw at least 6 threads inside the face of fitting or tank. Plugs, when inserted from the outside of tank heads, shall have the letter "S" at least ⅜ inch in size stamped with steel stamp or cast on the outside surface to indicate the plug is solid.

§ 179.200-22 Test of tanks.

(a) Each tank shall be tested by completely filling the tank and dome or nozzles with water, or other liquid having similar viscosity, of a temperature which shall not exceed 100 F. during the test; and applying the pressure prescribed in § 179.201-1. Tank shall hold the prescribed pressure for at least 10 minutes without leakage or evidence of distress. All rivets and closures, except safety relief valves or safety vents, shall be in place when test is made.

(b) Insulated tanks shall be tested

(c) Rubber-lined tanks shall be tested before rubber lining is applied.

(d) Caulking of welded joints to stop leaks developed during the foregoing tests is prohibited. Repairs in welded joints shall be made as prescribed in AAR Specifications for Tank Cars, Appendix W.

§ 179.200-23 Tests of safety relief valves.

(a) Each valve shall be tested by air or gas for compliance with § 179.201-1 before being put into service.

§ 179.200-24 Stamping.

(a) To certify that the tank complies with all specification requirements, each tank shall be plainly and permanently stamped in letters and figures at least ⅜ inch high into the metal near the center of both outside heads as follows:

	Example of required stamping
Specification	DOT-103-W
Material	ASTM A285 C
Cladding material (if any)	ASTM A240-304 Clad
Tank builder's initials	ABC
Date of original test	00-0000
Car assembler (if other than tank builder).	DEF

(b) On Class DOT-111 tank cars, the last numeral of the specification number may be omitted from the stamping; for example, DOT-111A100W.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21351, Nov. 6, 1971]

§ 179.200-25 Stenciling.

(a) The tank, or the jacket if tank is insulated, shall be stenciled in compliance with the requirements of AAR Specifications for Tank Cars, Appendix C.

§ 179.200-26 Certificate of construction.

(a) See § 179.5.

§ 179.201 Individual specification requirements applicable to non-pressure tank car tanks.

§ 179.201-1 Individual specification requirements.

(a) In addition to § 179.200 the individual specification requirements are as follows:

DOT specifications	103A-ALW	103AW	103ALW	103ANW	103BW	103CW	103DW	103EW
Material (see 179.200-7)	Al alloy	Steel	Al alloy	Nickel	Steel	Alloy steel	Alloy steel	Alloy steel.
Insulation (see § 179.200-4)	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional.
Bursting pressure p.s.i. (See § 179.200-5)	240	240	240	240	240	240	240	240
Minimum Plate thickness inches:								
Shell (see § 179.200-6)	½	179.201-2	½	179.201-2	179.201-2	179.201-2	179.201-2	179.201-2.
Heads (see § 179.200-6 and § 179.200-8).	½	179.201-2	½	179.201-2	179.201-2	179.201-2	179.201-2	179.201-2.
Dome	Required	Required	Required	Required	Required	Required	Required	Required.
Minimum expansion capacity (see § 179.200-14).	1 percent in dome.	1 percent in dome.	2 percent in dome.	1 percent in dome.	1 percent in dome.	1 percent in dome.	2 percent in dome.	1 percent in dome.
Test pressure p.s.i. (see § 179.200-22)	60	60	60	60	60	60	60	60.
Safety relief devices (see § 179.200-18)	Valve or vent	179.201-7	Valve or vent	179.201-7	Vent	Valve	Valve or vent	Valve or vent.
Valve start-to-discharge pressure p.s.i. (±3 p.s.i.).	35	35	35	35			35	35.
Valve vapor tight pressure (minimum p.s.i.).	28	28	28	28			28	28.
Valve flow rating pressure (maximum p.s.i.).	45	45	45	45			45	45.
Vent bursting pressure p.s.i.	60	60	60	60	60	Prohibited	60	60.
Gaging devices (see § 179.200-16)	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional.
Top loading and unloading devices (see § 179.200-16).	Required (valves optional).	Required (valves optional).	do	Required (valves optional).	Required (valves optional).	Required (valves optional).	do	Required (valves optional).
Bottom outlet (see § 179.200-17(a))	Prohibited	Prohibited	do	Prohibited	Prohibited	Prohibited	do	Prohibited.
Bottom washout (see § 179.200-17(b))	Optional	Optional	do	Optional	do	do	do	Optional.
Closure for manway (see § 179.200-15)			179.201-6(a)	179.201-6(d)	179.201-6(b)	179.201-6(c)	179.201-6(a), 179.201-6(c).	179.201-6(c).
Postweld heat treatment (HT) (see § 179.200-11).	Prohibited	HT	Prohibited	Not required	HT	HT 179.201-5	HT 179.201-5	HT 179.201-5.
		179.202-6						

Special references	179.202-10	179.202-7	179.202-1	179.202-8	179.201-3	179.201-4	179.201-4	179.201-4.
	179.202-14	179.202-8	179.202-21	179.202-11	179.202-9	179.202-14	179.202-1	179.202-11.
				179.202-16	179.202-12	179.202-15		
	179.202-12	179.202-11		179.202-17		179.202-19		179.202-15.
		179.202-12				179.202-21		
		179.202-13						
		179.202-18						
		179.202-17						
		179.202-20						
		179.202-22						
Material (see § 179.200-7)	Steel	Steel	Al alloy	Al alloy	Steel	Steel	Steel	Alloy steel.
Insulation (see § 179.200-4)	Optional	Optional	Optional	Optional	Required	Required (179.201-11).	Optional	Optional
Bursting pressure p.s.i. (see § 179.200-5)	240	240	240	240	240	240	240	240.
Minimum plate thickness inches:								
Shell (see § 179.200-6)	179.201-2	179.201-2	½	½	7/16	7/16	7/16	7/16.
Heads (see § 179.200-6 and § 179.200-8).	179.201-2	179.201-2	½	½	7/16	7/16	7/16	7/16.
Dome	Required	Required	None	None	None	None	None	None.
Minimum expansion capacity (see § 179.200-14).	2 percent in dome.	2 percent in dome.	2 percent in tank.	2 percent in tank.	2 percent in tank.	2 percent in tank.	2 percent in tank.	2 percent in tank.
Test pressure p.s.i. (see § 179.200-22)	60	60	60	60	60	60	60	60.
Safety relief devices (see § 179.200-18)	Valve or vent	Valve or vent	Valve or vent	Valve or vent	Valve or vent	179.201-7	Vent	Valve or vent.
Valve start-to-discharge pressure p.s.i. (±3 p.s.i.).	35	35	35	35	35	35	35	35.
Valve vapor tight pressure (minimum p.s.i.).	28	28	28	28	28	28	28	28.
Valve flow rating pressure (maximum p.s.i.).	45	45	45	45	45	45	45	45.
Vent bursting pressure p.s.i.	60	60	60	60	60	60	60	60.
Gaging devices (see § 179.200-16)	Optional	Optional	Required	Required	Required	Required	Required	Optional.
Top loading and unloading devices (see § 179.200-16).	do	do	Optional	Required (valves optional).	Optional	Required (valves optional).	Required (valves optional).	Required (valves optional).
Bottom outlet (see § 179.200-7(a))	do	do	do	Prohibited	do	Prohibited	Prohibited	Prohibited.
Bottom washout (see § 179.200-17(b))	do	do	do	Optional	do	Optional	do	Do.
Closure for manway (see § 179.200-15)	179.201-6(a)	179.201-6(a)	179.201-6(a)		179.201-6(a)		179.201-(b)	179.201-6(c).
Postweld heat treatment (HT) (see § 179.200-11).	HT	HT	Prohibited	Prohibited	HT	HT	HT	HT 179.201-5.
Special references	179.202-1	179.202-1	179.202-1	179.202-21	179.202-2		179.201-3	179.201-4.
	179.202-2				179.202-3			179.202-21.
	179.202-3				179.202-5			
	179.202-4				179.202-6			
	179.202-5							
	179.202-6							
	179.202-19							

DOT specifications	111A100ALW1	111A100ALW2	111A100W1[1]	111A100W2[1]	11A100W3	111A100W4	111A100W5	111A100W6	111A60F1,[1] 111A100F1,[1] 111A100F2[1]
Material (see § 179.200-7)	Al alloy	Al alloy	Steel	Steel	Steel	Steel	Steel	Alloy steel	
Insulation (see § 179.200-4)	Optional	Optional	Optional	Optional	Required	Required (§ 179.201-11).	Optional	Optional	
Bursting pressure p.s.i. (see § 179.200-5).	500	500	500	500	500	500	500	500	
Minimum plate thickness inches:									
Shell (see § 179.200-6)	⅝	⅝	7/16	7/16	7/16	7/16	7/16	7/16	
Heads (see § 179.200-6 and § 179.200-8).	⅝	⅝	7/16	7/16	7/16	7/16	7/16	7/16	
Dome	None	None	None	None	None	None	None	None	
Minimum expansion capacity (see § 179.200-14).	2 percent in tank.	2 percent in tank.	2 percent in tank.	2 percent in tank.	2 percent in tank.	Footnote 2	2 percent in tank.	2 percent in tank.	
Test pressure p.s.i. (see § 179.200-22).	100	100	100	100	100	100	100	100	
Safety relief devices (see § 179.200-18).	Valve or vent	Valve or vent	Valve or vent	179.201-7	Valve or vent	Valve	Vent	Valve or vent	
Valve start-to-discharge pressure p.s.i.(±3 p.s.i.).	75	75	75	75	75	75		75	
Valve vapor tight pressure (minimum p.s.i.).	60	60	60	60	60	60		60	
Valve flow rating pressure (maximum p.s.i.).	85	85	85	85	85	85		85	
Vent bursting pressure 100 p.s.i	100	100	100	100	100	Prohibited	100	100	
Gaging devices (see § 179.200-16)	Required	Required	Required	Required	Required	Required (179.201-9.	Required	Required	
Top loading and unloading devices (see § 179.200-16.	Optional	Required (valves optional).	Optional	Required (valves optional).	Optional (if used, valves required).	Required (valves required).	Required (valves optional).	Optional (if used, valves required).	
Bottom outlet (see § 179.200-17(a))	do	Prohibited	do	Prohibited	Optional	Prohibited	Prohibited	Optional	
Bottom washout (see § 179.200-17(b)).	do	Optional	do	Optional	do	do	do	do	
Closure for manway (see § 179.200-15).	179.201-6(a)		179.201-6(a)		179.201-6(a)	179.201-6(a)	179.201-6(b)	179.201-6(a) 179.201-6(c).	
Postweld heat treatment (HT) (see § 179.200-11).	Prohibited	Prohibited	HT	HT 179.202-6	HT	HT	HT	HT 179.201-5	

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Special references		179.202-21	179.202-1 179.202-2 179.202-5 179.202-6	179.202-7 179.202-8 179.202-11 179.202-12 179.202-13 179.202-16 179.202-17 179.202-20 179.202-22	179.201-1	179.201-8 179.201-10 179.202-1 179.202-18 179.202-19 179.202-20	179.201-3 179.202-9 179.202-12	179.201-4 179.202-1 179.202-14

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[1] Tanks converted to DOT-1A series from existing forge-welded specification DOT-105A 300, 490, or 500 tanks, by modification using conversion details complying with DOT-1-11A specification requirements, shall be stenciled by substituting the letter "F" for the letter "W" in the specification designation.

[2] See § 173.314(c) of this subchapter for compressed gases and § 173.116 of this subchapter for flammable liquids, unless otherwise specified in Part 173, Subpart C.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21352, Nov. 6, 1971; Amdt. 179-14, 39 FR 24911, July 8, 1974; Amdt. 179-22, 43 FR 8524, Mar. 2, 1978]

§ 179.201-2 Minimum plate thickness.

(a) The minimum plate thickness, after forming, must be as follows:

Inside diameter of tanks	Bottom sheets	Shell sheets	Expansion dome sheets	2:1 ellipsoidal heads	3:1 ellipsoidal and dished tank heads	Expansion dome heads	Interior compartment heads
	Inches						
60 inches or under	7/16	1/4	5/16	7/16	1/2	5/16	5/16
Over 60 to 78 inches	7/16	5/16	5/16	7/16	1/2	5/16	5/16
Over 78 to 96 inches	[1]1/2	3/8	5/16	7/16	1/2	5/16	3/8
Over 96 to 112 inches	[1]1/2	7/16	5/16	7/16	9/16	5/16	7/16
Over 112 to 122 inches	1/2	1/2	5/16	1/2	5/8	5/16	1/2

[1] May be reduced to 7/16 inch when approved steels having tensile strength of 65,000 psi or higher are used.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21352, Nov. 6, 1971]

§ 179.201-3 Lined tanks.

(a) Rubber-lined tanks.

(1) Each tank or each compartment thereof must be lined with acid-resistant rubber or other approved rubber compound vulcanized or bonded directly to the metal tank, to provide a nonporous laminated lining, at least 5/32-inch thick, except overall rivets and seams formed by riveted attachments in the lining must be double thickness. The rubber lining must overlap at least 1½ inches at all edges which must be straight and be beveled to an angle of approximately 45, or butted edges of lining must be sealed with a 3-inch minimum strip of lining having 45 beveled edges.

(2) As an alternate method, the lining may be joined with a skived butt seam then capped with a separate strip of lining 3 inches wide having 45 beveled edges. An additional rubber reinforcing pad at least 4½ feet square and at least ½-inch thick must be applied by vulcanizing to the lining on bottom of tank directly under the manway opening. The edges of the rubber pad must be beveled to an angle of approximately 45. An opening in this pad for sump is permitted. No lining must be under tension when applied except due to conformation over rivet heads. Interior of tank must be free from scale, oxidation, moisture, and all foreign matter during the lining operation.

(3) Other approved lining materials may be used provided the material is resistant to the corrosive or solvent action of the lading in the liquid or gas phase and is suitable for the service temperatures.

(b) Before a tank car tank is lined with rubber, or other rubber compound, a report certifying that the tank and its equipment have been brought into compliance with spec. DOT-103B, 103BW, 111A60W5, or 111A100W5 must be furnished by car owner to the party who is to apply the lining. A copy of this report in approved form, certifying that tank has been lined in compliance with all requirements of one of the above specifications, must be furnished by party lining tank to car owner. Reports of the latest lining application must be retained by the car owner until the next relining has been accomplished and recorded.

(c) All rivet heads on inside of tank must be buttonhead, or similar shape, and of uniform size. The under surface of heads must be driven tight against the plate. All plates, castings and rivet heads on the inside of the tank must be calked. All projecting edges of plates, castings and rivet heads on the inside of the tank must be rounded and free from fins and other irregular projections. Castings must be free from porosity.

(d) All surfaces of attachments or fittings and their closures exposed to the lading must be covered with at least ⅛-inch acid resistant material. Attachments made of metal not affected by the lading need not be covered with rubber or other acid resistant material.

(e) Hard rubber or polyvinyl chloride may be used for pressure retaining parts of safety vents provided the material is resistant to the corrosive or solvent action of the lading in the liquid or gas phase and is suitable for the service temperatures.

(f) Polyvinyl chloride lined tanks. Tank car tanks or each compartment thereof may be lined with elastomeric polyvinyl chloride having a minimum lining thickness of three thirty-seconds inch.

(g) Polyurethane lined tanks. Tank car tanks or each compartment thereof may be lined with elastomeric polyurethane having a minimum lining thickness of one-sixteenth inch.

[Amdt. 179-10, 36 FR 21352, Nov. 6, 1971]

§ 179.201-4 Material.

All fittings, tubes, and castings and all projections and their closures, except for protective housing, must also meet the requirements specified in AAR Specifications for Tank Cars, Appendix M, M3.03(b) and M4.05(d).

[Amdt. 179-10, 36 FR 21353, Nov. 6, 1971]

§ 179.201-5 Postweld heat treatment and corrosion resistance.

(a) Tanks and attachments welded directly thereto must be postweld heat treated as a unit at the proper temperature except as indicated below. Tanks and attachments welded directly thereto fabricated from ASTM A240-70 Type 430A, Type 304 and Type 316 materials must be postweld heat treated as a unit and must be tested to demonstrate that they possess the corrosion resistance specified in § 179.200-7(d), Footnote 2. Tanks and attachments welded directly thereto, fabricated from ASTM A240-70 Type 304L or Type 316L materials are not required to be postweld heat treated.

(b) Tanks and attachments welded directly thereto, fabricated from ASTM A240-70 Type 304L and Type 316 materials must be tested to demonstrate that they possess the corrosion resistance specified in § 179.200-7(d), Footnote 2.

[Amdt. 179-10, 36 FR 21353, Nov. 6, 1971]

§ 179.201-6 Manways and manway closures.

(a) The manway cover for spec. DOT 103ALW, 103DW, 103W, 104W, 111A60-ALW1, 111A60W1, 111A100ALW1, 111A-100W1, 111A100-W3, or 111A100W6 must be designed to make it impossible to remove the cover while the interior of the tank is subjected to pressure.

(b) The manway cover for spec. DOT 103BW, 11A60W5, or 111A100W5 must be made of a suitable metal. The top, bottom and edge of manway cover must be acid resistant material covered as prescribed in § 179.201-3. Through-bolt holes must be lined with acid resistant material at least one-eighth inch in thickness. Cover made of metal not affected by the lading need not be acid resistant material covered.

(c) The manway ring and cover for spec. DOT-103CW, 103DW, 103EW, 111360W7, or 11A100W6 must be made of the metal and have the same inspection procedures specified in AAR Specifications for Tanks Cars Appendix M, M3.03.

(d) The manway ring for DOT 103 ANW must be made of cast, forged or fabricated nickel and be a good weldable quality in conjunction with the metal of the dome. Manway cover must be made of nickel.

[Amdt. 179-10, 36 FR 21353, Nov. 6, 1971]

§ 179.201-7 Safety relief devices.

(a) Each tank or compartment must be equipped with a safety vent unless characteristics of the lading require a safety relief valve. These devices must comply with § 179.200-18.

(b) Safety vents, if used, shall be of approved design, at least 1¾ inches inside diameter, made of material not subject to rapid deterioration by the lading, and closed with a frangible disc of lead or other approved material of a thickness that will burst at not more than 100 percent of tank test pressure. Means for holding the disc in place shall be such as to prevent distortion or damage to the disc when applied. The safety vent closure shall be chained or otherwise fastened to prevent misplacement.

(c) Safety relief valves, if used, shall be of approved design, made of metal not subject to rapid deterioration by the lading, and mounted on expansion dome of Class DOT-103 and 104 type tanks, or top of tank shell for Class DOT-111A type tanks.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53 and App. A to Part 1)

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21353, Nov. 6, 1971; Amdt. 179-26, 45 FR 62083, Sept. 18, 1980]

§ 179.201-8 Sampling device and thermometer well.

(a) Sampling valve and thermometer well are not specification requirements. When used, they must be of approved design, made of metal not subject to rapid deterioration by lading, and must withstand a pressure of 100 pounds per square inch without leakage. Interior pipes of the sampling valve must be equipped with excess flow valves of an approved design. Interior pipe of thermometer well must be closed by an approved valve attached close to fitting where it passes through the tank and closed by a screw plug. Other approved arrangements that permit testing thermometer well for leaks without complete removal of the closure may be used.

§ 179.201-9 Gaging device.

A gauging device of an approved design must be applied to permit determining the liquid level of the lading. The gauging device must be made of materials not subject to rapid deterioration by the lading. When the interior pipe of the gauging device provides a means for passage of the lading from the interior to the exterior of the tank, it must be equipped with an excess flow valve of an approved design. If the opening for passage of lading through the gauging device is not more than 0.060 inch diameter an excess flow valve is not required. The gauging device must be provided with a protective housing.

[Amdt. 179-10, 36 FR 21353, Nov. 6, 1971]

§ 179.201-10 Water capacity marking.

(a) Water capacity of the tank in pounds stamped plainly and permanently in letters and figures at least ⅜ inch high into the metal of the tank immediately below the stamped marks specified in § 179.200-24(a). This mark shall also be stenciled on the jacket immediately below the dome platform and directly behind or within 3 feet of the right or left side of the ladder, or ladders, if there is a ladder on each side of the tank, in letters and figures at least 1½ inches high as follows:

WATER CAPACITY

000000 Pounds

§ 179.201-11 Insulation.

(a) Insulation shall be of sufficient thickness so that the thermal conductance at 60° F. is not more than 0.075 Btu per hour, per square foot, per degree F. temperature differential.

§ 179.202 Special commodity requirements for non-pressure tank car tanks.

(a) In addition to §§ 179.200 and 179.201 the following requirements are applicable:

§ 179.202-1 Flammable liquids not specifically provided for.

Tank cars used to transport flammable liquids not specifically provided for must have manway closures so designed that pressure will be released automatically by starting the operation of removing the manway cover. Specifications ARA-III, ARA-IV and ICC-103, DOT-103W, 103ALW, ICC-104, DOT-104W, 111A60ALW1 or 111A100W3, used to transport flammable liquids not specifically provided for, having a vapor pressure exceeding 27 pounds per square inch absolute at 100° F. but not exceeding 40 p.s.i.a. at 100° F., must have their manway closures equipped with approved safeguards making removal of closures from the manway opening practically impossible while car interior is subjected to vapor pressure of lading. These cars must be stenciled on each side of dome in line with the ladders, and in a color contrasting to the color of the dome with the identification mark as prescribed in AAR Specifications for Tank Cars, Appendix C.

[Amdt. 179-10, 36 FR 21353, Nov. 6, 1971 as amended by Amdt. 179-14, 39 FR 24911, July 8, 1974]

§ 179.202-2 Dimethyl dichlorosilane, ethyl dichlorosilane, ethyl trichlorosilane, methyl trichlorosilane, trimethyl chlorosilane, vinyl trichlorosilane, methyl dichlorosilane and trichlorosilane.

Tank cars used to transport dimethyl dichlorosilane, ethyl dichlorosilane, ethyl trichlorosilane, methyl trichlorosilane, trimethyl chlorosilane, vinyl trichlorosilane, methyl dichlorosilane and trichlorosilane, must not be equipped with bottom discharge outlet.

[Amdt. 179-10, 36 FR 21353, Nov. 6, 1971]

§ 179.202-3 Amyl mercaptan, Butyl mercaptan, Ethyl mercaptan, Isopropyl mercaptan, Propyl mercaptan, and Aliphatic mercaptan mixtures.

Tank cars used to transport amyl mercaptan, butyl mercaptan, ethyl mercaptan, isopropyl mercaptan, propyl mercaptan, and aliphatic mercaptan mixtures must have bottom outlets effectively sealed. Bottom washout permitted.

[Amdt. 179-10, 36 FR 21353, Nov. 6, 1971]

§ 179.202-4 Potassium nitrate mixed (fused) with Sodium nitrite.

Tank cars used to transport Potassium nitrate mixed (fused) with Sodium nitrite shall be specially designed, equipped, and approved for this service, without bottom discharge outlet and with heavier plate thicknesses than the minimum prescribed for cars built under this specification. For spec. 103-W tank cars made of plates having the minimum prescribed thicknesses, internal reinforcement of the upper sheets of tank in the region of the dome and reinforcing plates attached to the bottom sheet of the tank which rests on bolsters is required, and these tanks shall be equipped with baffle plates. Heater pipes shall be of welded construction designed for a test pressure of 500 pounds per square inch. A one inch woven asbestos lining shall be placed between bolster slabbing and bottom of tank to prevent heat transmission. Safety vents of the frangible disc type may be used and if used the frangible discs shall be perforated with ⅛ inch hole. If safety relief valves are used, a vacuum relief valve shall be installed on the dome.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21353, Nov. 6, 1971; Amdt. 179-25, 44 FR 20434, Apr. 5, 1979]

§ 179.202-5 Phosphorus, white or yellow.

Tank cars used to transport phosphorus, white or yellow, must be equipped with approved dome fittings, external heater systems and with insulation at least 4 inches in thickness, except that thickness of insulation may be reduced to 2 inches over external heater coils. Bottom washout nozzle of approved design may be applied. Bottom outlet for discharge of lading prohibited.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-6 Cumene hydroperoxide, diisopropylbenzene hydroperoxide and paramenthane hydroperoxide.

Tank cars used to transport cumene hydroperoxide of strength not exceeding 90 percent in a nonvolatile solvent. Paramenthane hydroperoxide of strength not exceeding 60 percent in a nonvolatile solvent and diisopropylbenzene hydroperoxide of strength not exceeding 60 percent in a nonvolatile solvent, must have bottom outlets effectively sealed from the inside.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-7 Titanium tetrachloride, anhydrous.

Tank cars used to transport titanium tetrachloride, anhydrous, must be equipped with safety relief valves. Safety vents not permitted.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-8 Chloracetyl chloride.

Tank cars used to transport chloracetyl chloride must have a nickel cladding of 1/16-inch minimum thickness. Nickel cladding in tanks must have a minimum nickel content of at least 99 percent pure nickel. Specification DOT-103ANW tank cars used to transport chloracetyl chloride must be of solid nickel at least 99 percent pure and all cast metal parts of the tank in contact with the lading must have a minimum nickel content of 96.7 percent.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-9 Hydrochloric (muriatic) acid, hydrochloric (muriatic) acid mixtures, hydrochloric (muriatic) acid solution, inhibited; sodium chlorite solution (not exceeding 42 percent sodium chlorite), and cleaning compounds, liquid, containing hydrochloric (muriatic) acid.

(a) For acids not over 38 percent strength by weight, except hydrochloric (muriatic) acid of not over 22° Baume strength, tank cars may be equipped with safety vent of approved design having a frangible disc with 1/8-inch breather hole in the center, or a safety vent of approved design using carbon discs permitting continuous venting.

(b) Sodium chlorite solution. Specification DOT-103CW tank cars having tanks of Type 304L stainless steel authorized for sodium chlorite solution not exceeding 42 percent sodium chlorite only.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-10 Hydrogen peroxide solution in water exceeding 52 percent by weight.

Tank cars used to transport hydrogen peroxide solution in water exceeding 52 percent by weight, must be equipped with a venting arrangement approved by the Bureau of Explosives.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-11 Phosphorus oxybromide, phosphorus oxychloride, phosphorus trichloride, and thiophosphoryl chloride.

Specification DOT-103ANW tank cars used to transport phosphorus oxybromide, phosphorus oxychloride, phosphorus trichloride, and thiophosphoryl chloride must be solid nickel at least 99 percent pure and all cast metal parts of the tank in contact with the lading have a minimum nickel content of approximately 96.7 percent. Specification DOT-103A tank cars used to transport phosphorus trichloride must be lead-lined steel, or made of steel at least 10 percent nickel clad. Specifications DOT-103AW, 111A100F2, or 111A100W2 tank cars used to transport phosphorus trichloride must be lead-lined steel or made of steel with a minimum thickness of nickel cladding of one-sixteenth inch. Nickel cladding in tanks must have a minimum nickel content of at least 99 percent pure nickel. Specification DOT-103EW tank cars used to transport phosphorus trichloride and thiophosphoryl chloride must have tanks fabricated from Type 316 stainless steel. Unlined specification DOT-103A, 103AW, 111A100F2, or 111A100W2 tank cars authorized for phosphorus trichloride only.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-12 Sulfuric acid of concentrations 65.25 percent (approximately 1.559 specific gravity) (52° Baume) or greater.

(a) Specifications DOT-103A, 103AW, 111A100F2, or 111A100W2 tank cars used for this service may be equipped with safety vent of approved design having a frangible disc with 1/8-inch breather hole in the center.

(b) Specifications DOT-103A, 103AW, 111A100F2, or 111A100W2 tank cars used in oleum and other fuming acids must be equipped with safety vent of approved design. Breather hole in frangible disc prohibited. Safety valve prohibited.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-13 Sulfur trioxide, stabilized.

Tank cars used to transport sulfur trioxide, stabilized must be equipped with *safety* relief valves of approved design. Tanks equipped with interior heating coils are not permitted. Specification 103AW tank cars may be equipped with standpipe electrical heaters approved by the AAR Committee on Tank Cars.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53(e))

[Amdt. 179-18, 42 FR 28135, June 2, 1977]

§ 179.202-14 Anhydrous hydrazine and hydrazine solutions containing 50 percent or less of water.

(a) Tank cars used to transport anhydrous hydrazine or hydrazine solutions containing 50 percent or less water, must have tanks fabricated of Type 304L stainless steel with molybdenum content not exceeding one-half of 1 percent. Specification DOT-111A100W6 tanks must not be equipped with bottom outlet.

(b) Safety relief valves for specification DOT-103CW tank cars may have a start-to-discharge pressure of 45 p.s.i. with a tolerance of plus or minus 3 p.s.i. and a vapor tight pressure of 36 p.s.i. Refer to AAR Specifications for Tank Cars, Appendix A, A8.05.

(c) Specification 103A-ALW tank cars authorized for transporting anhydrous hydrazine only, may have tanks equipped with a safety relief valve having start-to-discharge pressure of not more than 45 p.s.i. with a tolerance of plus or minus 3 p.s.i. and a vapor tight pressure of 36 p.s.i. Refer to AAR Specifications for Tank Cars, Appendix A, A8.05.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-15 Formic acid and formic acid solutions.

If a Specification DOT-103EW tank car tank is used, it must be fabricated from Type 316 stainless steel.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 179-25, 44 FR 20434, Apr. 5, 1979]

§ 179.202-16 Monochloroacetic acid, liquid.

(a) Tank cars used to transport monochloroacetic acid, liquid, must have tanks nickel clad at least 20 percent.

(b) Monochloroacetic acid anhydrous, when shipped as a liquid must be shipped in Specification 103ANW fabricated of 99 percent pure nickel or in 103AW or 111A6OW2 nickel clad at least 20 percent provided with a suitable corrosion resistant coating or lining.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971, as amended by Amdt. 179-12, 39 FR 15038, Apr. 30, 1974]

§ 179.202-17 Benzyl chloride.

Specification DOT-103ANW tank cars used to transport benzyl chloride must have all cast metal parts in contact with the lading made from metal having a minimum nickel content of 96.7 percent.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-18 Ethylene oxide.

(a) Each tank car used to transport ethylene oxide must be constructed to be in compliance with the following special requirements:

(1) The tank must be constructed in accordance with the DOT-111A100W4 specification.

(2) The safety relief valve, if not located on the manway nozzle, must be protected by an approved and insulated protective housing. Each safety relief valve must have its discharge piped to the top of the manway bonnet assembly or protective housing. Vapor exit from the manway bonnet assembly or protective housing must be provided through a full opening weather cap located directly above the safety valve vent pipe. Compliance with this provision is required after January 31, 1975, except that tank cars which are not in compliance and were built before January 31, 1975, must be in compliance by July 31, 1976.

(3) Copper, silver, mercury, magnesium, or their alloys may not be used in any part of the tank or appurtenances if that part or appurtenances is normally in contact with ethylene oxide liquid or vapor.

(4) Interior pipes of liquid discharge valves, vapor lines, gauging devices (when the device provides a means for passage of the lading from the interior to the exterior of the tank) and sampling lines must be equipped with excess flow valves of an approved design.

(5) Each tank must be equipped with a thermometer well.

(6) Each tank must be insulated with glass fiber except tank cars built before January 31, 1975, are author-

ized in this service when insulated with cork.

(7) Manway nozzles, cover plate, and protective housing must be of approved design. The manway protective housing and cover must be insulated with glass fiber or other material that will provide protection against heat deterioration of the valves and any resilient material contained within the housing. Compliance with this provision is mandatory after January 31, 1975, except that tank cars which are not in compliance and were built before January 31, 1975, must be in compliance by July 31, 1976.

(8) Neoprene, natural rubber, and asbestos gaskets are prohibited. All valve stem packings, O-rings, and gaskets must be constructed of materials which do not react spontaneously with or lower the autoignition temperature of ethylene oxide.

(9) Vacuum relief valves are prohibited.

(49 U.S.C. 1803, 1804, 1808; 49 CFR 1.53)

[Amdt. 179-14, 39 FR 24911, July 8, 1974, as amended by Amdt. 179-25, 44 FR 20434, Apr. 5, 1979]

§ 179.202-19 Dimethylhydrazine, unsymmetrical.

Tank cars used to transport dimethylhydrazine, unsymmetrical, must be equipped with steel safety valves of approved design. Specification DOT-103W tank cars must not be equipped with bottom outlets.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-20 Hydrofluoric acid.

Breather hole in frangible disc prohibited.

[Amdt. 179-10, 36 FR 21354, Nov. 6, 1971]

§ 179.202-21 Nitric acid.

(a) Tank cars used to transport nitric acid must comply with the following requirements:

(1) Bottom washout or bottom outlet is prohibited unless effectively sealed with an approved arrangement to prevent use during loading and unloading of acid.

(2) Safety vent is prohibited.

[Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.202-22 Mixed acid (nitric and sulfuric acid) (nitrating acid).

Specifications DOT-103A, 103AW, 111A100F1 or 111A100W2 tank cars used in nitrating and other fuming acids service must be equipped with safety vent of approved design. Breather hole in frangible disc prohibited. Safety valve prohibited.

[Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.220 General specifications applicable to nonpressure tank car tanks consisting of an inner container supported within an outer shell (class DOT-115).

[Amdt. 179-9, 36 FR 21340, Nov. 6, 1971]

§ 179.220-1 Tanks built under these specifications must meet the requirements of § 179.220 and § 179.221.

[Amdt. 179-9, 36 FR 21340, Nov. 6, 1971]

§ 179.220-2 Approval.

For procedures in securing approval, see § 179.3.

[Amdt. 179-9, 36 FR 21340, Nov. 6, 1971]

§ 179.220-3 Type.

(a) Tanks built under these specifications must consist of an inner container, a support system for the inner container, and an outer shell.

(b) The inner container must be a fusion welded tank of circular cross section with formed heads designed convex outward and must have a manway on top of the tank as prescribed herein. When the inner container is divided into compartments, each compartment must be considered a separate container.

(c) The outer shell must be a fusion welded tank with formed heads designed convex outward.

[Amdt. 179-9, 36 FR 21340, Nov. 6, 1971]

§ 179.220-4 Insulation.

The annular space between the inner container and the outer shell must contain an approved insulation material.

[Amdt. 179-9, 36 FR 21340, Nov. 6, 1971]

§ 179.220-5 Bursting pressure.

The minimum required bursting pressure of the inner container is listed in § 179.221-1.

[Amdt. 179-9, 36 FR 21340, Nov. 6, 1971]

§ 179.220-6 Thickness of plates.

(a) The wall thickness, after forming of the inner container shell and 2:1 ellipsoidal heads must be not less than specified in § 179.221-1, or not less than that calculated by the following formula:

$$t=Pd\ 1/2\ 6SE$$

where:

d=Inside diameter in inches;

E=0.9 welded joint efficiency; except E=1.0 for seamless heads;

P=Minimum required bursting pressure in p.s.i.;

S=Minimum tensile strength of plate material in p.s.i. as prescribed in AAR Specifications for Tank Cars, Appendix M, Table M1;

t=Minimum thickness of plate in inches after forming.

(b) The wall thickness after forming of the inner container heads, if flanged and dished, must be not less than specified in § 179.221-1, or not less than that calculated by the following formula:

$$t=5PL1/2SE$$

where:

E=0.9 welded joint efficiency; except E=1.0 for seamless heads;

L=Main inside radius to which head is dished, measured on concave side in inches;

P=Minimum required bursting pressure in p.s.i.;

S=Minimum tensile strength of plate material in p.s.i. as prescribed in AAR Specifications for Tank Cars, Appendix M., Table M1;

t=Minimum thickness of plate in inches after forming.

(c) The wall thickness after forming of the cylindrical section and heads of the outer shell must be not less than seven-sixteenths of an inch.

(d) See § 179.220-9 for plate thickness requirements for inner container when divided into compartments.

[Amdt. 179-9, 36 FR 21340, Nov. 6, 1971]

§ 179.220-7 Materials.

(a) The plate material used to fabricate the inner container and nozzles must meet one of the following specifications and with the indicated minimum tensile strength and elongation in the welded condition.

(b) Carbon steel plate: The maximum allowable carbon content must be 0.31 percent when the individual specification allows carbon content greater than this amount. The plates may be clad with other approved materials.

Specifications	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM A 515-70, Gr. 55	55,000	28
ASTM A 515-70, Gr. 60	60,000	25
ASTM A 515-70, Gr. 65	65,000	20
ASTM A 515-70, Gr. 70	70,000	20
ASTM A 285-70g, Gr. A	45,000	29
ASTM A 285-70a, Gr. B	50,000	20
ASTM A 285-70a, Gr. C	55,000	20
ASTM A 516-70a, Gr. 55	55,000	28
ASTM A 516-70a, Gr. 60	60,000	25
ASTM A 516-70a, Gr. 65	65,000	20
ASTM A 516-70a, Gr. 70	70,000	20
AAR TC128-70, Gr. A&B	81,000	19

[1] Maximum stresses to be used in calculations.

(c) Aluminum alloy plate: Aluminum alloy plate must be suitable for welding and comply with one of the following specifications:

Specifications	Minimum tensile strength (p.s.i.) 0 temper, welded condition [3] [6]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM B 209-70, Alloy 5052 [1]	25,000	18
ASTM B 209-70, Alloy 5083 [2]	38,000	16
ASTM B 209-70, Alloy 5086 [1]	35,000	14
ASTM B 209-70, Alloy 5154 [1]	30,000	18
ASTM B 209-70, Alloy 5254 [1]	30,000	18
ASTM B 209-70, Alloy 5454 [1]	31,000	18
ASTM B 209-70, Alloy 5652 [1]	25,000	18
ASTM B 209-70, Alloy 6061 [4]	[5] 24,000	[5] 5

[1] For fabrication, the parent plate material may be 0 H112, or H32 temper, but design calculations must be based on the minimum tensile strength shown.

[2] 0 temper only.

[3] Weld filler metal 5556 must not be used.

[4] Not authorized for tank shells, manways or domes.

[5] T6 temper only.

[6] Maximum stresses to be used in calculations.

(d) High alloy steel plate: High alloy steel plate must comply with one of the following specifications:

Specifications	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM A 240-70, Type 304	75,000	30
ASTM A 240-70, Type 304L	70,000	30
ASTM A 240-70, Type 316	74,000	30
ASTM A 240-70, Type 316L	70,000	30
ASTM A 240-70, Type 430A	65,000	22

[1] Maximum stresses to be used in calculations.

(e) Manganese-molybdenum steel plate: Manganese-molybdenum steel plate must be suitable for fusion welding and must comply with the following specification:

Specifications	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM A 302-70a, Gr. B	80,000	20

[1] Maximum stresses to be used in calculations.

(f) Plate materials used to fabricate the outer shell and heads must be those listed in paragraphs (b), (c), (d), or (e) of this section. The maximum allowable carbon content must be 0.31 percent when the individual specification allows carbon content greater than this amount. The plates may be clad with other approved materials.

(g) All appurtenances on the inner container in contact with the lading must be made of approved material compatible with the plate material of the inner container. These appurtenances must not be subject to rapid deterioration by the lading, or must be coated or lined with suitable corrosion resistant material. See AAR Specifications for Tank Cars, Appendix M, M4.05 for approved material specifications for castings for fittings.

[Amdt. 179-9, 36 FR 21340, Nov. 6, 1971]

§ 179.220-8 Tank heads.

(a) Tank heads of the inner container, inner container compartments and outer shell must be of approved contour, and may be flanged and dished or ellipsoidal for pressure on concave side.

(b) Flanged and dished heads must have main inside radius not exceeding 10 feet and inside knuckle radius must be not less than 3¾ inches for steel and alloy steel tanks nor less than 5 inches for aluminum alloy tanks.

(c) Ellipsoidal heads must be an ellipsoid of revolution in which the major axis must equal the diameter of the shell and the minor axis must be one-half the major axis.

[Amdt. 179-9, 36 FR 21341, Nov. 6, 1971]

§ 179.220-9 Compartment tanks.

(a) The inner container may be divided into compartments by inserting interior heads, or by fabricating each compartment as a separate container and joining with a cylinder, or by fabricating each compartment as a separate tank without a joining cylinder. Each compartment must be capable of withstanding, without evidence of yielding or leakage, the required test pressure applied in each compartment separately, or in any combination of compartments.

(b) When the inner container is divided into compartments by fabricating each compartment as a separate container and joining with a cylinder, the cylinder must have a plate thickness not less than that required for the inner container shell and must be applied to the outside surface of the straight flange portion of the container head. The cylinder must fit the straight flange tightly for a distance of at least two times the plate thickness, or 1 inch, whichever is greater and must be joined to the straight flange by a full fillet weld. Distance from fillet weld seam to container head seam must be not less than 1½ inches or three times the plate thickness, whichever is greater.

[Amdt. 179-9, 36 FR 21341, Nov. 6, 1971]

§ 179.220-10 Welding.

(a) All joints must be fusion-welded in compliance with AAR Specifications for Tank Cars, Appendix W. Welding procedures, welders, and fabricators shall be approved.

(b) Radioscopy of the outer shell is not a specification requirement.

(c) Welding is not permitted on or to ductile iron or malleable iron fittings.

[Amdt. 179-9, 36 FR 21341, Nov. 6, 1971]

§ 179.220-11 Postweld heat treatment.

(a) Postweld heat treatment of the inner container is not a specification requirement.

(b) Postweld heat treatment of the cylindrical portions of the outer shell to which the anchorage or draft sills are attached must comply with AAR Specifications for Tank Cars, Appendix W.

(c) When cold formed heads are used on the outer shell they must be heat treated before welding to shell if postweld heat treatment is not practicable due to assembly procedures.

[Amdt. 179-9, 36 FR 21341, Nov. 6, 1971]

§ 179.220-12 Tank mounting.

See § 179.10.

[Amdt. 179-9, 36 FR 21341, Nov. 6, 1971]

§ 179.220-13 Inner container manway nozzle and cover.

(a) Inner container manway nozzle must be of approved design with access opening at least 18 inches inside diameter, or at least 14 inches by 18 inches obround or oval.

(b) Manway covers must be of approved type. Design must provide a secure closure of the manway and must make it impossible to remove the cover while the tank interior is under pressure.

(c) All joints between manway covers and their seats must be made tight against leakage of vapor and liquid by use of suitable gaskets.

(d) Manway covers must be cast, forged, or fabricated metal complying with subsection § 179.220-7(g) of this section.

(e) A seal must be provided between the inner container manway nozzle and the opening in the outer shell.

[Amdt. 179-9, 36 FR 21341, Nov. 6, 1971]

§ 179.220-14 Openings in the tanks.

Openings in the inner container and the outer shell must be reinforced in compliance with AAR Specifications for Tank Cars, Appendix E. In determining the required reinforcement area for openings in the outer shell, *t* shall be one-fourth inch.

[Amdt. 179-9, 36 FR 21341, Nov. 6, 1971]

§ 179.220-15 Support system for inner container.

(a) The inner container must be supported within the outer shell by a support system of adequate strength and ductility at its operating temperature to support the inner container when filled with liquid lading to any level. The support system must be designed to support, without yielding, impact loads producing accelerations of the following magnitudes and directions when the inner container is loaded so that the car is at its rail load limit, and the car is equipped with a conventional AAR Specification M-901 draft gear.

Longitudinal	7G
Transverse	3G
Vertical	3G

(b) The longitudinal acceleration may be reduced to 3G where a cushioning device of approved design, which has been tested to demonstrate its ability to limit body forces to 400,000 pounds maximum at a 10 miles per hour impact, is used between the coupler and the tank structure. The support system must be of approved design and the inner container must be thermally isolated from the outer shell to the best practical extent.

[Amdt. 179-9, 36 FR 21341, Nov. 6, 1971]

§ 179.220-16 Expansion capacity.

Expansion capacity must be provided in the shell of the inner container as prescribed in § 179.221-1.

[Amdt. 179-9, 36 FR 21341, Nov. 6, 1971]

§ 179.220-17 Gauging devices, top loading and unloading devices, venting and air inlet devices.

(a) When installed, each device must be of approved design which will prevent interchange with any other fixture and must be tightly closed. Each unloading pipe must be securely anchored within the inner container. Each inner container or compartment thereof may be equipped with one separate air connection.

(b) When the characteristics of the commodity for which the car is authorized require these devices to be equipped with valves or fittings to permit the loading and unloading of the contents, these devices including valves, shall be provided with a protective housing except when plug or ball-type valves with operating handles removed are used. Provision must be made for closing pipe connections of valves.

(c) Inner container may be equipped with a vacuum relief valve of approved design. Protective housing is not required.

(d) When a gauging device is required in § 179.221-1, an outage scale visible through the manway opening must be provided. If loading devices are applied to permit tank loading with cover closed, a telltale pipe may be provided. The telltail pipe must be capable of determining that required outage is provided. The pipe must be equipped with ¼-inch maximum, NPT control valve mounted outside tank and enclosed within a protective housing. Other approved devices may be used in place of an outage scale or a telltale pipe.

(e) The bottom of the tank shell may be equipped with a sump or siphon bowl, or both, welded or pressed into the shell. These sumps or siphon bowls, if applied, are not limited in size and must be made of cast, forged, or fabricated metal. Each sump or siphon bowl must be of good welding quality in conjunction with the metal of the tank shell. When the sump or siphon bowl is pressed in the bottom of the tank shell, the wall thickness of the pressed section must not be less than that specified for the shell. The section of a circular cross section tank to which a sump or siphon bowl is attached need not comply with the out-of-roundness requirement specified in Appendix W, W14.06 of the AAR Specifications for Tank Cars. Any portion of a sump or siphon bowl not forming a part of a cylinder of revolution must have walls of such thickness and must be so reinforced that the stresses in the walls caused by a given internal pressure are not greater than the circumferential stress which would exist under the same internal pressure in the wall of a tank of circular cross section designed in accordance with §§ 179.220-6(a) and 179.220-9. In no case shall the wall thickness be less than that specified in § 179.221-1(a).

(f) Protective housing, when required, must be of approved material and must have cover and sidewalls not less than 0.119 inch in thickness.

[Amdt. 179-9, 36 FR 21341, Nov. 6, 1971]

§ 179.220-18 Bottom outlets.

(a) The inner container may be equipped with a bottom outlet of approved design and an opening provided in the outer shell of its access. If applied, the bottom outlet must comply with the following requirements:

(1) On newly built empty cars with truck centers through 60 feet, 6 inches, the extreme projection of the bottom outlet equipment including insulated enclosure must be at least 12 inches above the top of the rail on level track. On cars with truck centers greater than 60 feet, 6 inches, the minimum rail clearance must be in accordance with the graph in Appendix E of the AAR Specifications for Tank Cars. Each bottom outlet reducer and closure and their attachments must be secured to the car by at least a ⅜-inch chain or its equivalent. However, outlet closure plugs may be attached by ¼-inch chain. When the bottom outlet closure is of the combination cap and valve type, the pipe connection to the valve must be closed by a plug or cap.

(2) Each bottom outlet must be provided with a liquid tight closure at its lower end.

(3) The valve and its operating mechanism must be applied to the outside bottom of the inner container.

The valve operating mechanism must be provided with a suitable locking arrangement to insure positive closure during transportation.

(4) Valve outlet nozzle and valve body must be of cast, fabricated or forged metal. If welded to inner container, they must be of good weldable quality in conjunction with metal of tank.

(5) To provide for the attachment of unloading connections, the bottom of the main portion of the outlet nozzle or valve body, or some fixed attachment thereto, must be provided with threaded cap closure arrangement or bolted flange closure arrangement having minimum 1-inch threaded pipe plug.

(6) If the outlet nozzle and its closure extend below the bottom of the outer shell, a breakage groove or its equivalent must be applied. If a breakage groove is applied, a "V" must be cut (not cast) in the upper part of outlet nozzle at a point immediately below lowest part of valve to a depth that will leave thickness of nozzle wall at the root of the "V" not over one-fourth inch. The outlet nozzle or the valve body may be steam jacketed in which case the breakage groove or its equivalent must be below the steam chamber but above the bottom of the center sill construction. If the outlet nozzle is not a single piece or if exterior valves are applied, provision must be made for the equivalent of the breakage groove. On cars without continuous center sills, the breakage groove or its equivalent must not be more than 15 inches below the outer shell.

(7) The valve body must be of a thickness which will prevent distortion of the valve seat or valve by any change in contour of the shell resulting from expansion of lading, or other causes, and which will insure that accidental breakage of the outlet nozzle will occur at or below the "V" groove, or its equivalent.

(8) The valve must have no wings or stem projection below the "V" groove or its equivalent. The valve and seat must be readily accessible or removable for repairs, including grinding.

(b) Inner container may be equipped with bottom washout of approved design. If applied, bottom washout must comply with the following requirements:

(1) On newly built empty cars with truck centers through 60 feet, 6 inches, the extreme projection of the bottom washout equipment must be at least 12 inches above the top of rail on level track. On cars with truck centers greater than 60 feet, 6 inches, the minimum rail clearance must be in accordance with the graph in Appendix E of the AAR Specifications for Tank Cars.

(2) Bottom washout must be of cast, forged or fabricated metals. If it is welded to the inner container, it must be of good weldable quality in conjunction with metal of tank.

(3) If the washout nozzle extends below the bottom of the outer shell, a "V" groove must be cut (not cast) in the upper part of the nozzle at a point immediately below the lowest part of the inside closure seat or plug to a depth that will leave the wall thickness of nozzle at the root of the "V" not over one-fourth inch. Where the nozzle is not a single piece, provision must be made for the equivalent of the breakage groove. The nozzle must be of a thickness to insure that accidental breakage will occur at or below the "V" groove or its equivalent. On cars without continuous center sills, the breakage groove or its equivalent must not be more than 15 inches below the outer shell. On cars with continuous center sills, the breakage groove or its equivalent must be above the bottom of center sill construction.

(4) The closure plug and seat must be readily accessible or removable for repairs.

(5) The closure of the washout nozzle must be equipped with a ¾-inch solid screw plug. Plug must be attached by at least a ¼-inch chain.

(6) Joints between closures and their seats may be gasketed with suitable material.

[Amdt. 179-9, 36 FR 21342, Nov. 6, 1971]

§ 179.220-19 Safety relief devices.

(a) Each inner container or compartment must be equipped with safety relief devices of approved design as prescribed in § 179.221-1.

(b) When used, each safety relief valve must be made of metal not subject to rapid deterioration by the lading, and mounted on the top of the inner container. Total valve discharge capacity must be sufficient to prevent building up of pressure in the inner container to more than 10 p.s.i. above the start-to-discharge pressure. See AAR Specifications for Tank Cars, Appendix A, for formula for calculating discharge capacity. The start-to-discharge pressures and vapor tight pressures must comply with § 179.221-1.

(c) Each inner container or compartment used for the transportation of a corrosive liquid, a flammable solid, an oxidizing material, or a poisonous liquid or solid Class B, need not be equipped with a safety relief valve, but if not so equipped, it must have one safety vent at least 1¾ inches inside diameter made of material not subject to rapid deterioration by the lading. Each safety vent must be mounted on the top of the inner container. This vent must be of an approved design which will prevent interchange with fixtures prescribed in § 179.220-17. It must be closed with a frangible disc of lead or other approved material. Vent bursting pressure must comply with § 179.221-1. Tanks equipped with vents must be stenciled "Not for flammable liquids".

[Amdt. 179-9, 36 FR 21342, Nov. 6, 1971]

§ 179.220-20 Reinforcements, when used, and appurtenances not otherwise specified.

All attachments to inner container and outer shell must be applied by approved means.

[Amdt. 179-9, 36 FR 21342, Nov. 6, 1971]

§ 179.220-21 Interior heating system.

For heater system inside of inner container see § 179.12.

[Amdt. 179-9, 36 FR 21342, Nov. 6, 1971]

§ 179.220-22 Closure for openings.

(a) All plugs must be solid, with NPT threads, and must be of a length which will screw at least six threads inside the face of fitting or tank. Plugs, when inserted from the outside of the outer shell tank heads, must have the letter "S" at least three-eighths inch in size stamped with steel stamp or cast on the outside surface to indicate the plug is solid.

(b) Openings in the outer shell used during construction for installation must be closed in an approved manner.

[Amdt. 179-9, 36 FR 21343, Nov. 6, 1971]

§ 179.220-23 Test of tanks.

(a) Each inner container or compartment must be tested hydrostatically to the pressure specified in § 179.221-1. The temperature of the pressurizing medium must not exceed 100° F. during the test. The container must hold the prescribed pressure for at least 10 minutes without leakage or evidence of distress. Safety relief devices must not be in place when the test is made.

(b) The inner container must be pressure tested before installation within the outer shell. Items which, because of assembly sequence, must be welded to inner container after its installation within outer shell must have their attachment welds thoroughly inspected by a nondestructive dye penetrant method or its equivalent.

(c) Pressure testing of outer shell is not a specification requirement.

[Amdt. 179-9, 36 FR 21343, Nov. 6, 1971]

§ 179.220-24 Tests of safety relief valves.

Each safety relief valve must be tested by air or gas for compliance with § 179.221-1 before being put into service.

[Amdt. 179-9, 36 FR 21343, Nov. 6, 1971]

§ 179.220-25 Stamping.

To certify that the tank complies with all specification requirements, each outer shell must be plainly and permanently stamped in letters and figures at least ⅜-inch high into the metal near the center of both outside heads as follows:

	Examples of required stamping
Specifications	DOT-115A60W6
Inner container	
Material	ASTM A240-316L
Shell thickness	Shell 0.167 in.
Head thickness	Head 0.150 in.
Tank builders initials	ABC
Date of original test	00-0000

	Examples of required stamping
Outer shell:	
Material	ASTM A285-C.
Tank builders initials	WYZ.
Car assembler (if other than inner container or outer shell builders).	DEF.

[Amdt. 179-9, 36 FR 21343, Nov. 6, 1971]

§ 179.220-26 Stenciling.

(a) The outer shell, or the jacket if the outer shell is insulated, must be stenciled in compliance with AAR Specifications for Tank Cars, Appendix C.

(b) Stenciling must be applied on both sides of the outer shell or jacket near the center in letters and figures at least 1½ inches high to indicate the safe upper temperature limit, if applicable, for the inner tank, insulation, and the support system.

[Amdt. 179-9, 36 FR 21343, Nov. 6, 1971]

§ 179.220-27 Certificate of construction.

See § 179.5.

[Amdt. 179-9, 36 FR 21343, Nov. 6, 1971]

§ 179.221 Individual specification requirements applicable to tank car tanks consisting of an inner container supported within an outer shell.

[Amdt. 179-9, 36 FR 21343, Nov. 6, 1971]

§ 179.221-1 Individual specification requirements.

In addition to § 179.220, the individual specification requirements for the inner container are as follows:

Specification	115A60W1	115A60ALW	115A60W6
Inner container material (see § 179.220-7)	Steel	Al alloy	Alloy steel.
Bursting pressure, p.s.i. (see § 179.220-5)	240	240	240.
Minimum plate thickness, shell and heads, inches (see § 179.220-6).	⅛	$^3/_{16}$	⅛.
Minimum expansion capacity (see § 179.220-16)	2 percent in tank	2 percent in tank	2 percent in tank.
Test pressure, p.s.i. (see § 179.220-23)	60	60	60.
Safety relief device (see § 179.220-19)	Valve or vent	Valve or vent	Valve or vent.
Valve start-to-discharge pressure, p.s.i. (±3 p.s.i.)	35	35	35.
Valve vapor tight pressure (minimum, p.s.i.)	28	28	28.
Valve flow rating pressure (maximum, p.s.i.)	45	45	45.
Vent rupture pressure (maximum, p.s.i.)	45	45	45.
Gaging devices (see § 179.220-17)	Required	Required	Required.
Top loading and unloading devices (see § 179.220-17).	Optional	Optional	Optional.

[Amdt. 179-9, 36 FR 21343, Nov. 6, 1971]

Subpart E—Specifications for Multi-Unit Tank Car Tanks (Classes DOT-106A and 110AW)

§ 179.300 General specifications applicable to multi-unit tank car tanks designed to be removed from car structure for filling and emptying (Classes DOT-106A and 110AW).

[Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.300-1 Tanks built under these specifications shall meet the requirements of § 179.300, § 179.301 and when applicable, § 179.302.

§ 179.300-2 Approval.

(a) For procedure for securing approval, see § 179.3.

§ 179.300-3 Type and general requirements.

(a) Tanks built under this specification shall be cylindrical, circular in cross section, and shall have heads of approved design. All openings shall be located in the heads.

(b) Each tank shall have a water capacity of at least 1500 pounds and not more than 2600 pounds.

(c) For tanks made in foreign countries, a chemical analysis of materials and all tests as specified shall be carried out within the limits of the United States under the supervision of a competent and impartial inspector.

§ 179.300-4 Insulation.

(a) Tanks shall not be insulated.

§ 179.300-5 Bursting pressure.

(a) The minimum required bursting pressure is listed in § 179.301.

§ 179.300-6 Thickness of plates.

(a) For class DOT-110A tanks, the wall thickness after forming of the cylindrical portion of the tank must not be less than that specified in § 179.301 nor that calculated by the following formula:

$$t=Pd/2SE$$

where:

d = inside diameter in inches;
E = 1.0 welded joint efficiency;
P = minimum required bursting pressure in p.s.i.;
S = minimum tensile strength of plate material in p.s.i. as prescribed § 179.300-7;
t = minimum thickness of plate material in inches after forming.
t = minimum design thickness of plate in inches.

(b) For class DOT-106A tanks, the wall thickness of the cylindrical portion of the tank shall not be less than that specified in § 179.301 and shall be such that at the tank test pressure the maximum fiber stress in the wall of the tank will not exceed 15,750 p.s.i. as calculated by the following formula:

$$s=[p(1.3D^2+0.4d^2)]/(D^2-d^2)$$

where:

d = inside diameter in inches;
D = outside diameter in inches;
p = tank test pressure in p.s.i.;
s = wall stress in p.s.i.

(c) If plates are clad with material having tensile strength at least equal to the base plate, the cladding may be considered a part of the base plate when determining the thickness. If cladding material does not have tensile strength at least equal to the base plate, the base plate alone shall meet the thickness requirements.

[29 FR 18995, Dec. 29, 1964, as amended by Order 71, 31 FR 9083, July 1, 1966. Redesignated at 32 FR 5606, Apr. 5, 1967]

NOTE: For citations to additional amendments to § 179.300-6 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 179.300-7 Materials.

(a) Carbon steel plate material used to fabricate tanks having heads fusion welded to tank shell must comply with the following specifications with the indicated minimum tensile strength and elongation in the welded condition. The maximum allowable carbon content must be 0.31 percent when the individual specification allows carbon content greater than this amount. The plates may be clad with other approved materials:

Specifications	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM A 285-69 Gr. A	45,000	29
ASTM A 285-69 Gr. B	50,000	20
ASTM A 285-69 Gr. C	55,000	20
ASTM A 515-69 Gr. 65	65,000	20
ASTM A 515-69 Gr. 70	70,000	20

[1] Maximum stresses to be used in calculations.

(b) Carbon steel plate material used to fabricate tanks with forge welded heads must comply with the following specifications:

Specifications	Minimum tensile strength (p.s.i.) welded condition [1]	Minimum elongation in 2 inches (percent) welded condition (longitudinal)
ASTM A 285-69 Gr. A	45,000	29

[1] Maximum stresses to be used in calculations.

(c) All plates must have their heat number and the name or brand of the manufacturer legibly stamped on them at the rolling mill.

[Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.300-8 Tank heads.

(a) Class DOT-110A tanks shall have fusion-welded heads formed concave to pressure. Heads for fusion welding shall be an ellipsoid of revolution 2:1 ratio of major to minor axis. They shall be one piece, hot formed in one heat so as to provide a straight flange at least 1½ inches long. The thickness shall not be less than that calculated by the following formula:

$$t=Pd/2SE$$

where symbols are as defined in § 179.300-6(a).

(b) Class DOT-106A tanks must have forged-welded heads, formed convex to pressure. Heads for forge welding must be torispherical with an inside radius not greater than the inside diameter of the shell. They must be one piece, hot formed in one heat so as to provide a straight flange at least 4 inches long. They must have snug drive fit into the shell for forge welding. The wall thickness after forming must be sufficient to meet the test requirements of § 179.300-16 and to provide for adequate threading of openings.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.300-9 Welding.

(a) Longitudinal joints must be fusion welded. Head-to-shell joints must be forge welded on class DOT-106A tanks and fusion welded on class DOT-110A tanks. Welding procedures, welders and fabricators must be approved in accordance with AAR Specifications for Tank Cars, Appendix W.

(b) Fusion-welded joints must be in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W, except that circumferential welds in tanks less than 36 inches inside diameter need not be radiotaped.

(c) Forge-welded joints shall be thoroughly hammered or rolled to insure sound welds. The flanges of the heads shall be forge lapwelded to the shell and then crimped inwardly toward the center line at least one inch on the radius. Welding and crimping must be accomplished in one heat.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and as amended by Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.300-10 Postweld heat treatment.

After welding is complete, steel tanks and all attachments welded thereto, must be postweld heat treated as a unit in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W.

[Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.300-11 Tank mounting.

(a) For tank mounting, see § 179.10.

§ 179.300-12 Protection of fittings.

(a) Tanks shall be of such design as will afford maximum protection to any fittings or attachment to the head including the housing referred to in § 179.300-12(b). Tank ends shall slope or curve inward toward the axis so that the diameter at each end is at least 2 inches less than the maximum diameter.

(b) Loading and unloading valves shall be protected by a detachable protective housing of approved design which shall not project beyond the end of the tank and shall be securely fastened to the tank head. Safety relief devices shall not be covered by the housing.

§ 179.300-13 Venting, loading and unloading valves.

(a) Valves shall be of approved type, made of metal not subject to rapid deterioration by lading, and shall withstand tank test pressure without leakage. The valves shall be screwed directly into or attached by other approved methods to one tank head. Provision shall be made for closing outlet connections of the valves.

(b) Threads for openings shall be National Gas Taper Threads (NGT) tapped to gage, clean cut, even and without checks.

§ 179.300-14 Attachments not otherwise specified.

Siphon pipes and their couplings on the inside of the tank head and lugs on the outside of the tank head for attaching the valve protective housing must be fusion-welded in place prior to postweld heat treatment. All other fixtures and appurtenances, except as specifically provided for, are prohibited.

[Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.300-15 Safety relief devices.

(a) Unless prohibited in § 179.302, or in Part 173 of this chapter, tanks shall be equipped with one or more safety relief devices of approved type, made of metal not subject to rapid deterioration by the lading and screwed directly into tank heads or attached to tank heads by other approved methods.

The total discharge capacity shall be sufficient to prevent building up pressure in tank in excess of 82.5 percent of the tank test pressure. When safety relief devices of the fusible plug type are used, the required discharge capacity shall be available in each head. See AAR Specifications for Tank Cars, Appendix A, for formula for calculating discharge capacity.

(b) Threads for openings shall be National Gas Taper Threads (NGT) tapped to gage, clean cut, even and without checks.

(c) Safety relief valves shall be set for start-to-discharge and frangible discs shall burst at a pressure not exceeding that specified in § 179.301.

(d) Fusible plugs shall function at a temperature not exceeding 175° F. and shall be vapor-tight at a temperature of not less than 130° F.

§ 179.300-16 Tests of tanks.

(a) After postweld heat treatment, tanks shall be subjected to hydrostatic expansion test in a water jacket, or by other approved methods. No tank shall have been subjected previously to internal pressure within 100 pounds of the test pressure. Each tank shall be tested to the pressure prescribed in § 179.301. Pressure shall be maintained for 30 seconds and sufficiently longer to insure complete expansion of tank. Pressure gage shall permit reading to accuracy of one percent. Expansion gage shall permit reading of total expansion to accuracy of one percent. Expansion shall be recorded in cubic centimeters.

(1) No leaks shall appear and permanent volumetric expansion shall not exceed 10 percent of total volumetric expansion at test pressure.

(b) After all fittings have been installed, each tank shall be subjected to interior air pressure test of at least 100 p.s.i. under conditions favorable to detection of any leakage. No leaks shall appear.

(c) Repairs of leaks detected in manufacture or in foregoing tests shall be made by the same process as employed in manufacture of tank. Caulking, soldering, or similar repairing is prohibited.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.300-17 Tests of safety relief devices.

(a) Each valve shall be tested by air or gas before being put into service. The valve shall open and be vapor-tight at the pressure prescribed in § 179.301.

(b) Frangible discs of safety vents must be tested as prescribed in AAR Specifications for Tank Cars, Appendix A, A5.03.

(c) For safety relief devices of the fusible plug type, a sample of the plug used shall function at the temperatures prescribed in § 179.300-15.

(d) The start-to-discharge and vapor-tight pressures shall not be affected by any auxiliary closure or other combination.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.300-18 Stamping.

(a) To certify that the tank complies with all specification requirements, each tank shall be plainly and permanently stamped in letters and figures ⅜ inch high into the metal of valve end chime as follows:

(1) DOT Specification number.

(2) Material and cladding material if any (immediately below the specification number).

(3) Owner's or builder's identifying symbol and serial number (immediately below the material identification). The symbol shall be registered with the Bureau of Explosives, duplications are not authorized.

(4) Inspector's official mark (immediately below the owner's or builder's symbol).

(5) Date of original tank test (month and year, such as 1-64 for January 1964). This should be so placed that dates of subsequent tests may easily be added thereto.

(6) Water capacity—0000 pounds.

(b) A copy of the above stamping in letters and figures of the prescribed size stamped on a brass plate secured to one of the tank heads is authorized.

§ 179.300-19 Inspection.

(a) Tank shall be inspected within the United States and Canada by a competent and impartial inspector acceptable to the Bureau of Explosives. For tanks made outside the United States and Canada, the specified inspection shall be made within the United States.

(b) The inspector shall carefully inspect all plates from which tanks are to be made and secure records certifying that plates comply with the specification. Plates which do not comply with § 179.300-7 shall be rejected.

(c) The inspector shall make such inspection as may be necessary to see that all the requirements of this specification, including markings, are fully complied with; shall see that the finished tanks are properly stress relieved and tested.

(d) The inspector shall stamp his official mark on each accepted tank as required in § 179.300-18, and render the report required in § 179.300-20.

§ 179.300-20 Reports.

(a) Before a tank is placed in service, the inspector shall furnish to the builder, tank owner, Bureau of Explosives and the Secretary, Mechanical Division, Association of American Railroads, a report in approved form certifying that the tank and its equipment comply with all the requirements of this specification.

(b) For builder's Certificate of Construction, see § 179.5 (b), (c), and (d).

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21355, Nov. 5, 1971]

§ 179.301 Individual specification requirements for multi-unit tank car tanks.

(a) In addition to § 179.300 the individual specification requirements are as follows:

DOT specifications	106A500-X	106A800-X	110A500-W	110A800-W	110A1000-W
Bursting pressure, psi (see § 179.300-5)	(1)	(1)	1250	2000	2500
Minimum thickness shell, inches	$\frac{13}{32}$	$\frac{11}{16}$	$\frac{11}{32}$	$\frac{15}{32}$	$\frac{19}{32}$
Test pressure psi (see § 179.300-16)	500	800	500	800	1000
Safety relief devices psi (see § 179.300-15)					
Start-to-discharge, or burst maximum p.s.i.	375	600	375	600	700
Vapor-tight, minimum p.s.i.	300	480	300	480	650

[1] None specified.

[29 FR 18995, Dec. 29, 1964. Redesignated at 32 FR 5606, Apr. 5, 1967, and amended by Amdt. 179-10, 36 FR 21355, Nov. 6, 1971]

§ 179.302 Special commodity requirements for multi-unit tank car tanks.

(a) In addition to §§ 179.300 and 179.301, the following requirements are applicable:

Commodity	Safety relief device	Valve protective housing	Miscellaneous
Chlorine trifluoride	Prohibited [1]		
Chlorpicrin	do [1]	Gas tight [2]	
Hydrofluoric acid	do [1]	do	
Hydrogen sulfide	Fusible plugs required [7]	Required [6]	(3)
Methyl mercaptan	Prohibited [1]		
Nitric oxide	do [1]	Gas tight [2]	
Nitrogen dioxide liquid	do [1]	do [2]	
Nitrogen peroxide liquid	do [1]	do [2]	
Nitrogen tetroxide liquid	do [1]	do [2]	
Nitrogen tetroxide-nitric oxide mixtures	do [1]	do [2]	
Nitrosyl chloride	Fusible plugs required		(4)

Commodity	Safety relief device	Valve protective housing	Miscellaneous
Phosgene	Prohibited [1]	Gas tight [2]	
Titanium tetrachloride (anhydrous)	do [1]		
Vinyl chloride			(3)
Vinyl methyl ether			(3)

[1] When safety relief devices are prohibited, containers may be equipped with solid steel plugs in the safety device openings.

[2] The detachable protective housing for the loading and unloading valves must withstand tank test pressure without leakages and must be approved by the Bureau of Explosives.

[3] All parts of valves and safety relief devices in contact with the lading must be of a metal or other material, suitably treated if necessary, which will not cause formation of any acetylides.

[4] Tanks for nitrosyl chloride must be nickel-clad.

[5] Each valve outlet must be sealed by a threaded cap or a threaded solid plug.

[6] Valves must be protected by a metal cover.

[7] Safety relief devices for hydrogen sulfide must be of the fusible plug type utilizing a fusible alloy with yield temperature not over 170° F., nor less than 157° F. Each device must be resistant to extrusion of the fusible alloy and leak tight at 130° F.

[Amdt. 179-10, 36 FR 21355, Nov. 6, 1971, as amended by Amdt. 179-11, 38 FR 20086, July 27, 1973; Amdt. 179-13, 39 FR 17320, May 15, 1974]

Subpart F—Specifications for Liquefied Hydrogen Tank Car Tanks and Seamless Steel Tanks (Classes DOT-113A-W and 107A)

§ 179.400 General specifications applicable to liquefied hydrogen tank car tanks.

§ 179.400-1 General.

(a) Tanks built under these specifications must meet the requirements of §§ 179.400 and 179.401.

§ 179.400-2 Approval.

(a) For procedure for securing approval, see § 179.3.

§ 179.400-3 Type.

(a) A tank built in accordance with this specification shall consist of an inner (pressure) container suitably supported within an outer shell, and forming a part of a railway car. The car shall be equipped with piping systems for vapor venting, transfer of the lading and with safety relief devices, controls, gages and valves prescribed herein for safe operation of the unit in storage, transport and transfer of the lading.

(b) The inner (pressure) container shall be a fusion-welded cylindrical shell closed at each end with formed heads convex outward and suitable for operation at temperature as low as −423° F.

(c) The outershell shall be a fusion-welded cylindrical shell with formed heads.

(d) *Compartments.* When the interior of the tank is divided into compartments, each compartment must have two heads designed convex outward and comply with all other requirements described in this specification.

§ 179.400-4 Bursting pressure.

(a) The minimum required bursting pressure of the inner container is listed in § 179.401.

§ 179.400-5 Thickness of plates.

(a) The wall thickness of the inner container shell and heads shall not be less than that specified in § 179.401, nor that calculated by the following formula:

$$t = Pd/2SE$$

where:

d = inside diameter in inches;
E = efficiency of longitudinal welded joint—90 per cent;
P = minimum required bursting pressure in p.s.i.;
S = minimum ultimate tensile strength or plate material in p.s.i. as prescribed in § 179.400-6;
t = minimum design thickness of plate in inches.

§ 179.400-6 Materials.

(a) The material used in the shell, heads and appurtenances shall be suitable for use at minus 423° F. and compatible with the lading and the usual cleaning compounds recommended for this service. Chromium-nickel steel plate made to ASTM specification A-240-61T, Type 304, is an approved material and, when used, it shall be in the annealed condition prior to fabricating, forming or fusion-welding. Other approved materials may be used. The minimum ultimate tensile strength shall be as given in ASTM specification A-240, Type 304.

§ 179.400-7 Heads.

(a) The formed heads on the inner container shall preferably be ellipsoids of revolution in which the major axis shall equal the inside diameter of the shell and the minor axis shall be one-half of the major axis. The minimum thickness after forming shall be determined by the provisions of § 179.400-5(a) except that an efficiency of 100 percent may be used for a seamless head. Formed heads of other approved contours and thicknesses may be used but in no case shall the plate thickness be less than ³⁄₁₆ inch.

§ 179.400-8 Welding—inner container.

(a) All joints must be fusion-welded in compliance with the requirements of the AAR Specifications for Tank Cars, Appendix W, except that the following requirements supersede requirements listed under "Test Plates," "Bend Test," and "Impact Test" of Appendix W.

(b) *Test plates.* A welded test plate of the dimensions shown in Figure W-2 of AAR Specifications for Tank Cars, Appendix W shall be made for each container using the same weld procedure as used in welding the longitudinal seams of the container. Test plates shall be prepared from material having the same material specification and mill heat numbers as used in the shell or main heads of the inner container. After welding is completed, the test plate shall be radiographed, and the standards of judgment of weld acceptability as set forth in Par. 10.74-1 of AAR Specifications for Tank Cars, Appendix W, shall be followed.

(c) *Test specimens.* The following test specimens shall be removed from the welded test plate and subjected to the tests prescribed below:

(1) *Bend test.* Four transverse bend test specimens shall be removed from the welded test plate transverse to the welded joint of the test plate. The specimens shall be of rectangular cross section 1½ inches wide and the full thickness of the test plate. Weld reinforcements on each side of each test specimen shall be removed flush with the plane of the plate surface. Specimens shall be saw-cut from the test plate. Removal of test specimens from the test plate by means of flame cutting is prohibited. The specimens shall be subjected to a guided bend test, and two transverse face bend tests and two transverse root bend tests shall be performed. A bend test specimen that reveals no cracks or other open defects exceeding ⅛ inch measured in any direction on the convex surface of the specimen shall be considered to have passed the bend test. Cracks occurring on the corners of the specimen during the test shall not be considered as cause for rejection, unless there is definite evidence that they are the result of slag inclusions in the weld or other internal defects.

(2) *Impact tests.* Three sets of three impact test specimens shall be saw-cut from the welded test plate. These specimens shall be used for determining the impact properties of the plate material, weld zone and heat-affected zone. Impact test specimens shall be of the Charpy type, keyhole or milled U-notch, with the base of the notch normal to the plate surface, and shall conform in all respects to Figure 3 of ASTM Specification E-23-60-T. Impact test specimens shall be cooled in liquid nitrogen (−320° F.). The apparatus for testing the specimens shall be in accordance with the requirements of ASTM Specification E-23-60-T. The test piece and handling tongs shall be cooled for a length of time sufficient to reach the temperature of liquid nitrogen. The specimen shall be quickly transferred from the cooling device to the anvil of the testing machine and broken within a time lapse of not more than six seconds.

(3) *Impact properties.* The impact properties of each set of impact specimens shall be not less than the values listed below:

Size of specimen	Minimum impact value required for average of each set of 3 specimens	Minimum impact value permitted on 1 specimen only of each set of 3 specimens
	Feet-Pound	
55 mm × 10 mm × 10 mm	15	10
55 mm × 10 mm × 7.5 mm	12.5	8.5
55 mm × 10 mm × 5 mm	10	7
55 mm × 10 mm × 2.5 mm	5	3.5

Where the average value of the three specimens equals or exceeds the minimum value permitted for a single specimen, and the value for more than one specimen is less than the minimum value required for the average of the three specimens, or when the impact value of one specimen is below the minimum value permitted for a single specimen, a retest of three additional specimens shall be made. The value from each retest specimen shall equal or exceed the minimum value required for the average of three specimens given above. When an erratic result is caused by a defective specimen or there is uncertainty in the test procedure, a retest is authorized.

§ 179.400–9 Stress relieving.

(a) Stress relieving of the inner container is not a requirement of this specification.

§ 179.400–10 Cleaning interior container.

(a) The interior of the tank and all lines connecting to it shall be thoroughly cleaned. Proper precautions shall be taken to avoid subsequent recontamination of the system after cleaning.

§ 179.400–11 Test of inner container.

(a) After all items to be welded to the inner container have been welded in place, the inner container shall be pressurized hydrostatically or pneumatically to the test pressure prescribed in § 179.401. The temperature of the pressurizing medium shall not exceed 100° F. during the test. The container shall hold the prescribed pressure for a period of not less than ten minutes without leakage or evidence of distress. Due regard should be taken of the potential hazard involved in a pneumatic test. After the container has passed the pressure test, the container and piping shall be emptied of all water and purged of all water vapor if water is used for testing.

(b) Caulking of welded joints to stop leaks developed during the foregoing test is prohibited. Repairs to welded joints shall be made as prescribed in § 179.400–8.

§ 179.400–12 Radiography.

(a) All longitudinal and circumferential double-butt, fusion-welded joints of the inner container and outer shell shall be examined throughout their entire length by the X-ray or gamma-ray method of radiography. The standards of judgment for acceptability of welds examined by radiography shall be in accordance with Paragraph 10.74-1 of AAR Specifications for Tank Cars, Appendix W.

§ 179.400–13 Support system for inner container.

(a) The inner container shall be supported within the outer shell by a support system of adequate strength and ductility at its operating temperature to support the inner container when filled with liquid lading to any level incidental to operation of the complete unit as a railway tank car. The support system shall be designed to be capable of supporting, without yielding, impact loads producing accelerations of the following magnitudes and directions when the inner container is fully loaded, and the car is equipped with a conventional AAR Specification M-901 draft gear:

Longitudinal	7G
Transverse	3G
Vertical	3G

The longitudinal acceleration may be reduced to 3G where a cushioning device of approved design, which has been tested to demonstrate its ability to limit body forces to 400,000 pounds maximum at 10 miles per hour, is used between the coupler and the tank structure. The support system shall be of an approved design and such that the inner container shall be thermally isolated from the outer shell to the best practical extent.

§ 179.400–14 Access to inner container.

(a) The inner container shall be provided with a means of access having a minimum inside diameter of 16 inches and having a welded closure so designed as to allow it to be reopened by grinding or chipping and to be closed again by rewelding without a need for new parts. A cutting torch shall not be used. The closure and the reinforcement of the opening in the container shall be of approved design and made of the same material as is used in the container. Consideration must be given in the design to minimizing contamination of the container and the vacuum space when the closure is opened and closed. The outer shell shall be provided with an access opening of sufficient size (and aligned with the container access opening) to permit removal of the container closure and access into the container. The closure and the reinforcement of the opening in the outer shell shall be of approved design and made of the same material as is used in the outer shell. The closure shall preferably be so designed as to allow it to be reopened by grinding or chipping and to be closed again by rewelding without a need for new parts. A passageway connecting the inner container with the outer shell is not a specification requirement.

§ 179.400-15 Outer shell.

(a) *Design.* The outer shell shall be designed to withstand an external pressure of one atmosphere.

(b) *Thickness of plates.* The wall thickness of steel plates in the cylindrical portion of the outer shell shall be not less than 7/16 inch.

(c) *Material.* All plate material in the outer shell shall be flange quality or firebox quality steel, made to an approved specification, the carbon content of which shall not exceed 0.31 percent. Steel plate materials in accordance with material specifications listed in Group 1, Table A of AAR Specifications for Tank Cars, Appendix W, are approved for use in the outer shell of tanks built to this specification.

(1) All steel castings, steel forgings and steel structural shapes shall be of material to an approved specification.

(2) Rivets, when used, shall be of steel to an approved specification.

(d) *Heads.* The formed heads at each end of the outer shell preferably shall be an ellipsoid of revolution in which the major axis shall equal the inside diameter of the shell and the minor axis shall be one-half of the major axis. Formed heads of other approved contours may be used, but in no case shall the wall thickness be less than 7/16 inch.

(e) *Stiffening rings.* If stiffening rings are used in designing the cylindrical portion of the outer shell for external pressure, they shall be attached to the shell by means of fillet welds on each side of the ring. Outside stiffening ring attachment welds shall be continuous. Inside ring attachment welds may be intermittent. When intermittent welds are used, the total length of welds on each side of the ring shall not be less than one-third of the circumference of the outer shell. Where a closed section is used, it shall be continuously welded on the outside of each leg. A portion of the outer shell may be included when calculating the moment of inertia of the ring. The effective width of shell plate, W, on each side of the attachment of the stiffening ring is given by:

$$W = 0.78\sqrt{Rt}$$

where:

W = width of shell effective on each side of the stiffener—inches;

R = outside radius of the outer shell—inches;

t = plate thickness of the outer shell—inches.

Where a stiffener is used which consists of a closed section having two webs attached to the outer shell, the shell plate between the webs shall be included up to the limit of twice the value of W defined above. The outer "flange" of the section shall be subject to the same limitation with W based on the R and t of the flange. Where two separate members, such as two angles, are located less than 2W apart they may be treated as a single stiffening member. (The maximum length of shell plate which may be considered effective is 4W.)

(1) The stiffener rings shall have a moment of inertia large enough to support an external pressure of 37.5 p.s.i.g. as determined by either of the following formulae:

$$I = 0.035D^3LP_c/E$$
$$I^1 = 0.046D^3LP_c/E$$

where:

I = required moment of inertia of stiffener about centroidal axis parallel to vessel axis—inches^4;

I^1 = required moment of inertia of combined section of stiffener and effective width of shell plate, about centroidal axis parallel to vessel axis—inches^4;

D = outside diameter of outer shell—inches;
L = one-half of the distance from the centerline of the stiffening ring to the next line of support on one side, plus one-half of the centerline distance to the next line of support, if any, on the other side of the stiffening ring, both measured parallel to the axis of the vessel—inches. (A line of support is: (1) A stiffening ring which meets the requirements of this paragraph, or (2) a circumferential line on a head at one-third the depth of the head from the head tangent line.);
P_c = critical collapsing pressure (37.5 p.s.i.g. minimum);
E = modulus of elasticity of stiffener material—p.s.i.

(2) The cylindrical portion of the outer shell between stiffening rings shall be stiff enough to withstand an external pressure of 37.5 p.s.i.g. (critical collapsing pressure) as determined by the following formula:

$$P_c = [2.6E(t/D)^{2.5}]/[L/D\ 0.45(t/D)^{0.5}]$$

where:

P_c = critical collapsing pressure (37.5 p.s.i.g. minimum);
E = modulus of elasticity of shell material—lb./sq. inch;
t = minimum thickness of shell material—inches;
D = outside diameter of shell—inches;
L = distance between stiffening ring centers—inches. (The heads may be considered as stiffening rings located one-third of the head depth from the head tangent line.)

(3) The permissible out-of-roundness of the cylindrical portion of the outer shell shall be no greater than that permitted in Section VIII for out-of-roundness for external pressure of the ASME Boiler and Pressure Vessel Code.

(4) Where loads are applied to the outer shell or to the stiffening rings from the support system used to support the inner container within the outer shell, additional stiffener rings or an increased moment of inertia of stiffening rings designed for the external pressure will have to be provided to carry the support loads.

(f) *Welding.* All joints shall be fusion-welded in compliance with the requirements of AAR Specifications for Tank Cars, Appendix W. Welding procedures, welders and fabricators shall be approved. No more than two circumferential closing joints in the cylindrical portion of the outer shell, including head to shell joints, shall be single-welded butt joints using a backing strip on the inside of the joint. If the interior of the outer shell is divided into compartments, the compartment heads shall be attached inside the shell by fillet welding.

(g) *Stress relieving.* The cylindrical portion of the outer shell with the exception of the circumferential closing seams shall be stress relieved in accordance with the requirements of Par. W-15.01 of the AAR Specifications for Tank Cars, Appendix W. All items welded to the shell shall be attached before stress relieving. Welds securing the inner container support system to the outer shell which cannot feasibly be made before final assembly and the tank heads at each end of the shell need not be stress relieved.

(h) *Tests of outer shell.* Pressure testing of outer shell is not a specification requirement.

§ 179.400-16 Insulation.

(a) The annular space between the two shells shall contain an approved insulating system so installed as to insure against excessive settling and the creation of voids in the insulation when the car is in service. The material shall not burn or spark when touched with a glowing platinum wire in an atmosphere of air or lading. The insulation shall be such that the total heat transfer from the atmosphere at ambient temperature to the hydrogen at atmospheric pressure will not vaporize more than 5.2 pounds of liquefied hydrogen per hour (1000 scfh at 60° F.) when the car is stationary.

(b) *Annular space.* The distance between the outside wall of the inner container and the inside wall of the outside shell shall be not less than two inches.

§ 179.400-17 Piping, vacuum line, vapor phase line, loading and unloading lines.

(a) *Vacuum lines.* The outer shell shall be provided with fittings to permit effective evacuation of the annular space between the outer shell and inner container.

(b) *Product lines.* The piping systems for vapor and liquid phase transfer and venting shall be made from materials compatible with the product and having satisfactory properties at minus 423° F. All valves, gages, and closures shall be mounted within suitable protective housings. The outlets of all vapor phase and liquid phase lines shall be so located that accidental discharge from these lines will not impinge on any metal of the outer shell, car structure, trucks or safety appliances.

(c) *Vapor phase line.* Vapor phase line of sufficient size to permit safety devices covered in § 179.400-18(c) (1) and (2) connected to this line to operate at their designed capacity without excessive pressure buildup in the tank shall connect to the inner container. The vapor phase line shall have a manually operated shut-off valve located as close as possible to the outer shell and shall have a closure that is liquid and gas tight.

(d) *Vapor phase blow-down line.* A blow-down line shall be provided and it may be attached to the vapor phase line specified in § 179.400-17(c) and ahead of the shut-off valve in that line. It shall have a manually operated shut-off valve located as close as possible to the outer shell. The outlet from this line shall be outside its housing and positioned so that the discharge will be directed upward and away from operating personnel.

(e) *Pressure building system.* Not a specification requirement. If a pressure building system is provided for the purpose of pressurizing the vapor space of the inner container to facilitate unloading the liquid lading, the system shall be of approved design.

(f) *Loading and unloading line.* A liquid phase transfer line shall be provided and shall have a manually operated, vacuum jacketed, shut-off valve located as close as possible to the outer shell. The section of line between the outer shell and the valve shall be vacuum jacketed. A vapor trap shall be incorporated in the line and shall be located as close as possible to the inner shell.

§ 179.400-18 Safety relief devices.

(a) The tank shall be provided with safety relief devices for the protection of the tank assembly and piping systems. The discharge from these devices shall be directed away from operating personnel, principal load bearing members of the outer shell, car structure, trucks and safety appliances. Vent or weep holes in safety devices are prohibited. All main safety relief devices shall discharge to the outside of protective housings in which they are mounted. This provision does not apply to small safety relief valves installed to protect isolated short sections of lines between the final valve and end closure.

(b) *Materials.* Materials used in safety relief devices shall be suitable for use at minus 423° F. and otherwise compatible with hydrogen in the liquid or vapor phase.

(c) *Inner container.* Safety relief devices for the inner container shall be attached to piping connected to the vapor phase of the inner container and mounted so as to remain in ambient temperature prior to operation. Additional requirements are as follows:

(1) *Safety vent.* The inner container shall be equipped with a safety vent without an intervening shut-off valve and designed to function at a pressure less than the test pressure of the inner container, The safety vent capacity shall be sufficient to limit the pressure within the inner container to not over the test pressure during all conditions of operation, both normal and abnormal, including fire with loss of vacuum, when the insulation space is filled with gaseous hydrogen at atmospheric pressure. The discharge shall be directed upward.

(2) *Safety relief valve.* The inner container shall be equipped with a safety relief valve without an intervening shut-off valve and set to start to discharge at a pressure not greater than 75 percent of the test pressure prescribed in § 179.401, less 15 psi. Safety relief valve capacity shall be sufficient to limit the pressure within the inner container to 85 percent of the test pressure, less 15 psi, even when the insulation space is filled with gaseous

hydrogen at atmospheric pressure (no vacuum) and the outer shell is at 130° F. The minimum size relief valve body shall be ¾ inch IPS. The discharge shall be directed upward. See AAR Specifications for Tank Cars, Appendix A, for formula for calculating discharge capacity.

(3) *Pressure control device.* The inner container shall be equipped with an approved device to prevent the discharge of a mixture exceeding 50 percent of the lower flammable limit to the atmosphere under normal conditions of storage and transport of lading. This device shall be set to start to discharge at a pressure not greater than 17 psig and shall have sufficient capacity to limit the pressure within the inner container to 17 psig when the discharge is equal to twice the normal venting rate during transportation with normal vacuum and the outer shell at 130° F.

(4) *Safety interlock.* Not a specification requirement. If a safety interlock is provided for the purpose of allowing transfer of the lading at a pressure higher than the pressure control device setting but less than the safety relief valve setting, the design shall be as follows:

(i) The safety interlock shall not affect the discharge path of the safety relief valve or safety vent at any time. The safety interlock shall automatically provide an unrestricted discharge path for the pressure control device at all times except when the inner container is being pressurized through the vapor vent line shut-off valve for the transfer of lading. The safety interlock shall automatically prevent operation of the pressure control device only when the inner container is being pressurized through the vapor vent line shut-off valve for transfer of lading. Automatic operation shall be assured by a mechanical interlock of approved design between the vapor vent line shut-off valve and a pressure control device shut-off valve.

(d) *Outer shell.* The outer shell shall be provided with a suitable relief device to prevent build up of internal pressure in excess of 16 psig. The discharge capacity of the relieving device shall be sufficient to vent pressure accumulating within the annular space. Safety vent, if used, shall be designed to prevent distortion of the frangible disc when the annular space is evacuated.

(e) *Piping system.* Additional safety relief valves shall be installed in each piping circuit where the system can be isolated by closing the shut-off valves so that a dangerous pressure can be built up. These safety relief valves shall be designed to open at a pressure sufficiently low to prevent damage to the component or system affected.

§ 179.400–19 Tests of safety relief valves.

(a) Each valve shall be tested by air or gas for compliance with § 179.401 before being put into service.

§ 179.400–20 Control valves and gauges.

(a) *Control valves.* (1) Manually-operated shut-off valves and control valves shall be provided wherever needed for control of the vapor phase pressure, vapor phase venting, liquid transfer and liquid flow rates.

(2) Control valves and shut-off valves shall be designed and constructed to provide positive shut-off, and to provide minimum resistance to flow when open. These valves shall be so constructed that the packing glands and control handles are separated from the valve bodies by a sufficient length of low conductivity material to reduce to minimum the collection of frost on the control handles when low temperatures gas or liquid is passing through or in contact with the valve parts.

(3) Control valve and shut-off valves shall be of approved design and fabricated from materials not adversely affected by extended periods of contact with the lading in the liquid or vapor phase, or moist air and water.

(4) Packing, if used in these valves, shall be satisfactory for use in contact with the lading in the liquid or vapor phase and shall be of approved materials which will effectively seal the valve stem without causing difficulty of operation.

(5) Control valves and shut-off valves shall be so installed that they can be readily operated and their control handles will be readily accessible to the operator. These valves shall be

so mounted that operation of the valves will not transmit excessive forces to the piping system.

(b) Instruments necessary to the effective and safe operation of the tank when transporting, transferring or storing the liquid commodities for which the car is designed shall be provided. Instruments, except portable instruments, shall be securely mounted on panels within suitable protective housings and shall include the following:

(1) *Liquid level gauge.* Connections shall be provided for a liquid level gauge of approved design to indicate the quantity of liquefied hydrogen within the inner container. The gauge, if not portable, shall be mounted in a position where it will be readily visible to an operator during transfer operations or storage. The connection for a portable gauge must be readily accessible.

(2) *Fixed dip tube.* A fixed length dip tube shall be provided with a manually operated shut-off valve located as close as possible to the outer shell and within a suitable housing. It shall be so installed as to indicate the maximum liquid level for the allowable filling density at 1 psig.

(3) *Vapor phase pressure gauge.* A vapor phase pressure gauge of approved design shall be provided to indicate the vapor pressure within the inner container. The gauges shall be mounted so as to be readily visible to an operator.

(4) *Vacuum gauge.* Connections shall be provided for a vacuum gauge of approved design to indicate the absolute pressure in the annular space between the outer shell and the inner container. The gauge, if not portable, must be mounted in a position where it will be readily visible to an operator. The connection for a portable gauge must be readily accessible.

§ 179.400-21 Protective housings.

(a) The protection housings specified for all valves, gauges, and closures shall be designed to protect the enclosed components from direct solar radiation, mud, sand, adverse environmental exposure, and mechanical damage. The housings shall be so designed as to provide reasonable access to the enclosed components for operation, inspection, and maintenance, and so that vapor concentration cannot build up to a dangerous level inside the housings in the event of valve leakage or pop safety valve operation. The closure shall be operable by personnel wearing heavy gloves and shall incorporate provisions for locks or seals.

§ 179.400-22 Operating instructions.

(a) *Identification.* All valves and gauges shall be clearly identified with corrosion-resistant name plates. A plate of corrosion-resistant material bearing directions and precautionary instructions for the safe operation of this equipment during storage and transfer operations shall be securely mounted so as to be readily visible to an operator. This instruction plate shall be mounted in each housing containing operating equipment and controls for product handling. The instructions shall be clear, concise and adequate in the description of the operations to be performed by the operator during storage or transfer operations. These instructions shall include a diagram of the tank and its piping system, with the various gauges, control valves, and safety relief devices clearly identified and located. The operating instructions for the vacuum system may be on a separate plate which is installed only in the housing containing vaccum controls and gauges.

§ 179.400-23 Stamping.

(a) Each tank shall be marked certifying that the tank complies with all requirements of this specification. These marks shall be as follows:

(1) DOT ——— (insert applicable number per § 179.401) in letters and figures at least ⅜ inch high stamped plainly and permanently into the metal near the center of the main head of the outer shell at the "B" end of the car by the tank builder or the party assembling the complete tank unit. This mark must also be stenciled on the outer shell in letters and figures at least 1½ inches high by the party assembling the complete car.

(2) Initials of the builder of the inner container, together with information as to the material used for the shell and heads of the inner container, shell thickness, head thickness and inside diameter of the inner container, shall be stamped in letters and figures at least ⅜ inch high into the metal immediately below the marks specified in § 179.400-23(a)(1).

(3) Initials of builder of the outer shell in letters and figures at least ⅜ inch high stamped plainly and permanently into the metal immediately below the marks specified in paragraph (a)(2) of this section.

(4) Date of original test of inner container and initials of party conducting the test in letters and figures at least ⅜ inch high plainly and permanently stamped immediately below the marks specified in paragraph (a)(3) of this section. Any marking, stenciling or stamping on the shell or heads of the inner container is prohibited. These markings must also be stenciled on the outer shell in letters and figures at least 1½ inches high.

(5) Initials of company assembling the complete car in letters and figures at least ⅜ inch high plainly and permanently stamped immediately below the marks specified in paragraph (a)(4) of this section. These marks shall also be stenciled on the outer shell in letters and figures at least 1½ inches high.

(6) In lieu of stamping required in paragraphs (a) (1), (2), (3), (4), and (5) of this section, the markings specified by these paragraphs may be incorporated on a data plate of corrosion-resistant metal fillet welded in place on the main head of the outer shell of the "B" end of the car.

§ 179.400-24 Stenciling.

(a) The outer shell of the tank shall be stenciled in compliance with the requirements of AAR Specifications for Tank Cars, Appendix C.

(1) Date on which the principal safety relief valves were tested, pressure at which tested, place where tested and initials of party making test shall be stenciled on the outer shell in letters and figures at least 1 inch high.

(2) The date on which the frangible disc was replaced and the initials of the party making the replacement shall be stenciled on the outer shell in letters and figures 1 inch high. The identification of the manufacturer, the type of frangible disc installed, and the rated rupture pressure is normally shown on the tab of the disc. If it is not given thereon, this information shall also be stenciled on the outer shell in letters and figures 1 inch high.

(3) Tank cars of approved design built to this specification are authorized for the transportation of "LIQUEFIED HYDROGEN ONLY" and shall be stenciled in letters at least 2 inches high on the outer shell immediately above the marks specified in § 179.400-23(a)(1).

§ 179.400-25 Reports.

(a) Certificate of Construction, see § 179.5.

§ 179.401 Individual specification requirements for liquefied hydrogen tank car tanks.

(a) In addition to § 179.400 the individual specification requirements are as follows:

DOT specification	1	113A175-W
Material (see § 179.400-6)	(1)	(1)
Bursting pressure, psi (see § 179.400-4)	240	440
Minimum thickness, inches, shell, and head	$\frac{3}{16}$	$\frac{5}{16}$
Test pressure, psi (see § 179.400-11)	60	175
Safety relief devices:		
Safety vent, maximum, bursting pressure, psi	60	175
Tolerance, psi	+0, −10	+0, −22
Safety relief valve:		
Start-to-discharge	30	115
Start-to-discharge tolerance	±2.0	±4.0
Vapor-tight, minimum	24	95
Pressure control device: Start-to-vent, psi maximum	17	17
Outer shell safety vent, psi maximum	16	16

[1] Stainless steel.

§ 179.500 Specification DOT-107A * * * * seamless steel tank car tanks.

§ 179.500-1 Tanks built under these specifications shall meet the requirements of § 179.500.

§ 179.500-2 Approval.

(a) For procedure for securing approval, see § 179.3.

§ 179.500-3 Type and general requirements.

(a) Tanks built under this specification shall be hollow forged or drawn in one piece. Forged tanks shall be machined inside and outside before ends are necked-down and, after necking-down, the ends shall be machined to size on the ends and outside diameter. Machining not necessary on inside or outside of seamless steel tubing, but required on ends after necking-down.

(b) For tanks made in foreign countries, chemical analysis of material and all tests as specified must be carried out within the limits of the United States under supervision of a competent and disinterested inspector; in addition to which, provisions in § 179.500-18 (b) and (c) shall be carried out at the point of manufacture by a recognized inspection bureau with principal office in the United States.

(c) The term "marked end" and "marked test pressure" used throughout this specification are defined as follows:

(1) "Marked end" is that end of the tank on which marks prescribed in § 179.500-17 are stamped.

(2) "Marked test pressure" is that pressure in pounds per square inch which is indicated by the figures substituted for the **** in the marking DOT-107A **** stamped on the marked end of tank.

(d) The gas pressure at 130 F in the tank shall not exceed 7/10 of the marked test pressure of the tank.

§ 179.500-4 Thickness of wall.

(a) Minimum thickness of wall of each finished tank shall be such that at a pressure equal to 7/10 of the marked test pressure of the tank, the calculated fiber stress in pounds per square inch at inner wall of tank multiplied by 3.0 will not exceed the tensile strength of any specimen taken from the tank and tested as prescribed in § 179.500-7(b). Minimum wall thickness shall be ¼ inch.

(b) Calculations to determine the maximum marked test pressure permitted to be marked on the tank shall be made by the formula:

$$P=[10S(D^2-d^2)]/[7(D^2+d^2)]$$

where:

P = Maximum marked test pressure permitted;

$$S=U/2.0$$

where:

U = Tensile strength of that specimen which shows the lower tensile strength of the two specimens taken from the tank and tested as prescribed in § 179.500-7(b).

3 = Factor of safety.

$(D^2-d^2/(D^2+d^2)$ = The smaller value obtained for this factor by the operations specified in § 179.500-4(c).

(c) Measure at one end, in a plane perpendicular to the longitudinal axis of the tank and at least 18 inches from that end before necking-down:

d = Maximum inside diameter (inches) for the location under consideration; to be determined by direct measurement to an accuracy of 0.05 inch.

t = Minimum thickness of wall for the location under consideration; to be determined by direct measurement to an accuracy of 0.001 inch.

Take $D=d+2t$.

Calculate the value of $(D^2-d^2)/(D^2+d^2)$

(1) Make similar measurements and calculation for a corresponding location at the other end of the tank.

(2) Use the smaller result obtained, from the foregoing, in making calculations prescribed in paragraph (b) of this section.

§ 179.500-5 Material.

(a) Tanks shall be made from open-hearth or electric steel of uniform quality. Material shall be free from seams, cracks, laminations, or other defects injurious to finished tank. If not free from such defects, the surface may be machined or ground to eliminate these defects. Forgings and seamless tubing for bodies of tanks shall be stamped with heat numbers.

(b) Steel (see Note 1) must conform to the following requirements as to chemical composition:

Designation	Class I (percent)	Class II (percent)	Class III (percent)
Carbon, maximum	0.50	0.50	0.53
Manganese, maximum	1.65	1.65	1.85
Phosphorus, maximum	.05	.05	.05
Sulphur, maximum	.06	.05	.05
Silicon, maximum	.35	.30	.37
Molybdenum, maximum		.25	.30
Chromium, maximum		.30	.30
Sum of manganese and carbon not over	2.10	2.10	

NOTE 1: Alternate steel containing other alloying elements may be used if approved.

(1) For instructions as to the obtaining and checking of chemical analysis, see § 179.500-18(b)(3).

§ 179.500-6 Heat treatment.

(a) Each necked-down tank shall be uniformly heat treated. Heat treatment shall consist of annealing or normalizing and tempering for Class I, Class II and Class III steel or oil quenching and tempering for Class III steel. Tempering temperatures shall not be less than 1000° F. Heat treatment of alternate steels shall be approved. All scale shall be removed from outside of tank to an extent sufficient to allow proper inspection.

(b) To check uniformity of heat treatment, Brinnel hardness tests shall be made at 18 inch intervals on the entire longitudinal axis. The hardness shall not vary more than 35 points in the length of the tank. No hardness tests need be taken within 12 inches from point of head to shell tangency.

(c) A magnetic particle inspection shall be performed after heat treatment on all tanks subjected to a quench and temper treatment to detect the presence of quenching cracks. Cracks shall be removed to sound metal by grinding and the surface exposed shall be blended smoothly into the surrounding area. A wall thickness check shall then be made of the affected area by ultrasonic equipment or other suitable means acceptable to the inspector and if the remaining wall thickness is less than the minimum recorded thickness as determined by § 179.500-4(b) it shall be used for making the calculation prescribed in paragraph (b) of this section.

§ 179.500-7 Physical tests.

(a) Physical tests shall be made on two test specimens 0.505 inch in diameter within 2-inch gauge length, taken 180 degrees apart, one from each ring section cut from each end of each forged or drawn tube before necking-down, or one from each prolongation at each end of each necked-down tank. These test specimen ring sections or prolongations shall be heat treated, with the necked-down tank which they represent. The width of the test specimen ring section must be at least its wall thickness. Only when diameters and wall thickness will not permit removal of 0.505 by 2-inch tensile test bar, laid in the transverse direction, may test bar cut in the longitudinal direction be substituted. When the thickness will not permit obtaining a 0.505 specimen, then the largest diameter specimen obtainable in the longitudinal direction shall be used. Specimens shall have bright surface and a reduced section. When 0.505 specimen is not used the gauge length shall be a ratio of 4 to 1 length to diameter.

(b) Elastic limit as determined by extensometer, shall not exceed 70 percent of tensile strength for class I steel or 85 percent of tensile strength for class II and class III steel. Determination shall be made at cross head speed of not more than 0.125 inch per minute with an extensometer reading to 0.0002 inch. The extensometer shall be read at increments of stress not exceeding 5,000 pounds per square inch. The stress at which the strain first exceeds

stress (pounds per square inch)/30,000,000 (pounds per square inch) +0.005 (inches per inch)

shall be recorded as the elastic limit.

(1) Elongation shall be at least 18 percent and reduction of area at least 35 percent.

NOTE 1: Upon approval, the ratio of elastic limit to ultimate strength may be raised to permit use of special alloy steels of definite composition that will give equal or better physical properties than steels herein specified.

(Sec. 9 of the Department of Transportation Act (49 U.S.C. 1657); title VI and sec. 902(h), Federal Aviation Act of 1958, 49 U.S.C. 1421-1430 and 1472(h))

[Amdt. 179-8, 36 FR 18470, Sept. 15, 1971]

§ 179.500-8 Openings in tanks.

(a) Each end shall be closed by a cover made of forged steel. Covers shall be secured to ends of tank by through bolts or studs not entering interior of tank. Covers shall be of a thickness sufficient to meet test requirements of § 179.500-12 and to compensate for the openings closed by attachments prescribed herein.

(1) It is also provided that each end may be closed by internal threading to accommodate an approved fitting. The internal threads as well as the threads on fittings for these openings shall be clean cut, even, without checks, and tapped to gauge. Taper threads are required and shall be of a length not less than as specified for American Standard taper pipe threads. External threading of an approved type shall be permissible on the internal threaded ends.

(b) Joints between covers and ends and between cover and attachments shall be of approved form and made tight against vapor or liquid leakage by means of a confined gasket of suitable material.

§ 179.500-9 Tank mounting.

(a) For tank mounting, see § 179.10.

§ 179.500-10 Protective housing.

(a) Safety devices, and loading and unloading valves on tanks shall be protected from accidental injury by approved metal housing, arranged so it may be readily opened to permit inspection and adjustment of safety relief devices and valves, and securely locked in closed position. Housing shall be provided with opening having an opening equal to twice the total discharge area of safety relief device enclosed.

§ 179.500-11 Loading and unloading valves.

(a) Loading and unloading valve or valves shall be mounted on the cover or threaded into the marked end of tank. These valves shall be of approved type, made of metal not subject to rapid deterioration by lading or in service, and shall withstand without leakage a pressure equal to the marked test pressure of tank. Provision shall be made for closing service outlet of valves.

§ 179.500-12 Safety relief devices.

(a) Tank shall be equipped with one or more safety relief devices of approved type and discharge area, mounted on the cover or threaded into the non-marked end of the tank. If fittings are mounted on a cover, they shall be of the flanged type, made of metal not subject to rapid deterioration by lading or in service. Total flow capacity shall be such that, with tank filled with air at pressure equal to 70 percent of the marked test pressure of tank, flow capacity will be sufficient to reduce air pressure to 30 percent of the marked test pressure within 3 minutes after safety relief device opens.

(b) Safety relief devices shall open at pressure not exceeding the marked test pressure of tank and not less than $\frac{7}{10}$ of marked test pressure. (For tolerance for safety relief valves, see § 179.500-16(a).)

(c) Cars used for the transportation of flammable gases shall have the safety devices equipped with an approved ignition device.

§ 179.500-13 Fixtures.

(a) Attachments, other than those mounted on tank covers or serving as threaded closures for the ends of the tank, are prohibited.

§ 179.500-14 Test of tanks.

(a) After heat-treatment, tanks shall be subjected to hydrostatic tests in a water jacket, or by other accurate method, operated so as to obtain reliable data. No tank shall have been subjected previously to internal pressure greater than 90 percent of the marked test pressure. Each tank shall be tested to a pressure at least equal to the marked test pressure of the tank. Pressure shall be maintained for 30 seconds, and sufficiently longer to insure complete expansion of tank. Pressure gauge shall permit reading to accuracy of one percent. Expansion gauge shall permit reading of total expansion to accuracy of one percent. Expansion shall be recorded in cubic centimeters.

(b) No leaks shall appear and permanent volumetric expansion shall not exceed 10 percent of the total volumetric expansion at test pressure.

§ 179.500-15 Handling of tanks failing in tests.

(a) Tanks rejected for failure in any of the tests prescribed may be reheat-treated, and will be acceptable if subsequent to reheat-treatment they are subjected to and pass all of the tests.

§ 179.500-16 Tests of safety relief devices.

(a) Safety relief valves shall be tested by air or gas before being put into service. Valve shall open at pressure not exceeding the marked test pressure of tank and shall be vapor-tight at 80 percent of the marked test pressure. These limiting pressures shall not be affected by any auxiliary closure or other combination.

(b) For safety relief devices of frangible disc type, samples of discs used shall burst at a pressure not exceeding the marked test pressure of tank and not less than 7/10 of marked test pressure.

§ 179.500-17 Marking.

(a) Each tank shall be plainly and permanently marked, thus certifying that tank complies with all requirements of this specification. These marks shall be stamped into the metal of necked-down section of tank at marked end, in letters and figures at least ¼ inch high, as follows:

(1) Spec. DOT-107A * * * *, the * * * * to be replaced by figures indicating marked test pressure of the tank. This pressure shall not exceed the calculated maximum marked test pressure permitted, as determined by the formula in § 179.500-4(b).

(2) Serial number immediately below the stamped mark specified in paragraph (a)(1) of this section.

(3) Inspector's official mark immediately below the stamped mark specified in paragraph (a)(1) of this section.

(4) Name, mark (other than trademark), or initials of company or person for whose use tank is being made, which shall be recorded with the Bureau of Explosives.

(5) Date (such as 1-62, for January 1962) of tank test, so placed that dates of subsequent tests may easily be added thereto.

(6) Date (such as 1-62, for January 1962) of latest test of safety relief valve or of frangible disc, required only when tank is used for transportation of flammable gases.

(7) Name of gas for which tank car is being used, stenciled in letters at least 2 inches high on each side of car where they are clearly visible.

§ 179.500-18 Inspection and reports.

(a) Before a tank car is placed in service, the party assembling the completed car shall furnish to car owner, Bureau of Explosives, and the Secretary, Mechanical Division, Association of American Railroads, a report in proper form certifying that tanks and their equipment comply with all the requirements of this specification and including information as to serial numbers, dates of tests, and ownership marks on tanks mounted on car structure.

(b) Purchaser of tanks shall provide for inspection by a competent inspector as follows:

(1) Inspector shall carefully inspect all material and reject that not complying with § 179.500-5.

(2) Inspector shall stamp his official mark on each forging or seamless tube accepted by him for use in making tanks, and shall verify proper application of heat number to such material by occasional inspections at steel manufacturer's plant.

(3) Inspector shall obtain certified chemical analysis of each heat of material.

(4) Inspector shall make inspection of inside surface of tanks before necking-down, to insure that no seams, cracks, laminations, or other defects exist.

(5) Inspector shall fully verify compliance with specification, verify heat treatment of tank as proper; obtain samples for all tests and check chemical analyses; witness all tests; and report minimum thickness of tank wall, maximum inside diameter, and

calculated value of D, for each end of each tank as prescribed in § 179.500-4(c).

(6) Inspector shall stamp his official mark on each accepted tank immediately below serial number, and make certified report (see paragraph (c) of this section) to builder, to company or person for whose use tanks are being made, to builder of car structure on which tanks are to be mounted, to the Bureau of Explosives, and to the Secretary, Mechanical Division, Association of American Railroads.

(c) Inspector's report required herein shall be in the following form:

(Place) ——————————
(Date) ——————————

STEEL TANKS

It is hereby certified that drawings were submitted for these tanks under AAR Application for Approval ——— and approved by the AAR Committee on Tank Cars under date of ———.

Built for —————————— Company
Location at ——————————
Built by —————————— Company
Location at ——————————
Consigned to —————— Company
Location at ——————————
Quantity ——————————
Length (inches) ——————————
Outside diameter (inches) ——————————
Marks stamped into tank as required in § 179.500-17 are:

DOT-107A* * * *

NOTE 1: The marked test pressure substituted for the * * * * on each tank is shown on Record of General Data on Tanks attached hereto.

Serial numbers —— to —— inclusive
Inspector's mark ——————————
Owner's mark ——————————
Test date ——————————
Water capacity (see Record of Hydrostatic Tests).
Tare weights (yes or no) (see Record of Hydrostatic Tests).
These tanks were made by process of ————

Steel used was identified as indicated by the attached list showing the serial number of each tank, followed by the heat number.

Steel used was verified as to chemical analysis and record thereof is attached hereto. Heat numbers were stamped into metal. All material was inspected and each tank was inspected both before and after closing in ends; all material accepted was found free from seams, cracks, laminations, and other defects which might prove injurious to strength of tank. Processes of manufacture and heat-treatment of tanks were witnessed and found to be efficient and satisfactory.

Before necking-down ends, each tank was measured at each location prescribed in § 179.500-4(c) and minimum wall thickness in inches at each location was recorded; maximum inside diameter in inches at each location was recorded; value of D in inches at each location was calculated and recorded; maximum fiber stress in wall at location showing larger value for

$$(D^2+d^2)/(D^2-d^2)$$

was calculated for $^{7}/_{10}$ the marked test pressure and recorded. Calculations were made by the formula:

$$S=[0.7P(D^2-d^2)/(D^2+d^2)]$$

Hydrostatic tests, tensile test of material, and other tests as prescribed in this specification, were made in the presence of the inspector, and all material and tanks accepted were found to be in compliance with the requirements of this specification. Records thereof are attached hereto.

I hereby certify that all of these tanks proved satisfactory in every way and comply with the requirements of Department of Transportation Specification No. 107A* * * *.

(Signed) ——————————
(Inspector)
(Place) ——————————
(Date) ——————————

RECORD OF CHEMICAL ANALYSIS OF STEEL FOR TANKS

Numbered ——— to ——— inclusive
Size —— inches outside diameter by —— inches long
Built by —————————— Company
For —————————— Company

Heat No	Tanks represented (serial Nos.)	Chemical analysis							
		C	Mn	P	S	Si	Ni	Cr	Mo

These analyses were made by
(Signed) ——————————
(Place) ——————————
(Date) ——————————

RECORD OF CHEMICAL ANALYSIS OF STEEL IN TANKS

Numbered ——— to ——— inclusive
Size —— inches outside by —— inches long
Built by —————————— Company
For —————————— Company

Heat No.	Tanks represented by test (serial Nos.)	Elastic limit (pounds per square inch)	Tensile strength (pounds per square inch)	Elongation (percent in 2 inches)	Reduction of area (percent)

(Signed) ————————
(Place)..
(Date)..

RECORD OF HYDROSTATIC TESTS ON TANKS

Numbered.. to .... inclusive
Size .... inches outside by .... inches long
Built by.. Company
For.. Company

Serial Nos. of tanks	Actual test pressure (pounds per square inch)	Total expansion (cubic centimeters)	Permanent expansion (cubic centimeters)	Percent ratio of permanent expansion to total expansion [1]	Tare weight (pounds) [2]	Capacity in pounds of water at 60° F

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[1] If tests are made by method involving measurement of amount of liquid forced into tank by test pressure, then the basic data on which calculations are made, such as pump factors, temperature of liquid, coefficient of compressibility of liquid, etc., must also be given.

[2] Do not include protective housing, but state whether with or without valves.

(Signed)..
(Place)..
(Date)..

RECORD OF GENERAL DATA ON TANKS

Numbered.. to .... inclusive
Built by.. Company
For.. Company

Data obtained as prescribed in § 179.500-4(c)										
Marked end of tank				Other end of tank						
Serial No. of tank	(t) Min. thickness of wall in inches	(d) Max. inside diameter in inches	(D) Calculated value of D in inches $= d+2t$	(t) Minimum thickness of wall in inches	(d) Maximum inside diameter in inches	(D) calculated value of D in inches $= d+2t$	Larger value of the factor D^2+d^2/D^2-d^2	(S) Calculated fiber stress in pounds per square inch at $^7/_{10}$ marked test pressure	Marked test pressure in pounds per square inch stamped in tank	Minimum tensile strength of material in pounds per square inch recorded

(Signed)..

SUBCHAPTER D—PIPELINE SAFETY

PART 190—PIPELINE SAFETY PROGRAM PROCEDURES

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AUTHORITY: 49 U.S.C. 1672, 1677, 1679, 1679b, 1680, 1681; 49 U.S.C. 2002, 2006, 2007, 2008, 2009, 2010; sections applicable to offshore gas gathering lines also issued under 49 U.S.C. 1804; 49 CFR 1.53 and Appendix A to Part I.

SOURCE: 45 FR 20413, Mar. 27, 1980, unlesss otherwise noted.

Subpart A—General

§ 190.1 Purpose and scope.

(a) This part prescribes procedures utilized by the Materials Transportation Bureau and the Office of Operations and Enforcement in carrying out their duties regarding pipeline safety under the Natural Gas Pipeline Safety Act of 1968, as amended (49 U.S.C. 1671 *et. seq.*), the Hazardous Liquid Pipeline Safety Act of 1979 (Title II of Pub. L. 96-129 November 30, 1979), and the Hazardous Materials Transportation Act, as amended (49 U.S.C. 1801 *et. seq.*).

(b) This subpart defines certain terms and prescribes procedures that are applicable to each proceeding described in this part.

§ 190.3 Definitions.

As used in this part:

(a) "The NGPSA" means the Natural Gas Pipeline Safety Act of 1968, as amended 49 U.S.C. 1671 *et. seq.* The regulations prescribed in this part and Parts 191, 192 and 193 of Subchapter D are issued under the authority of the NGPSA.

(b) "The HLPSA" means the Hazardous Liquid Pipeline Safety Act of 1979 (Title II of Pub. L. 96-129). The regulations prescribed in this part and Part 195 of Subchapter D are issued under the authority of the HLPSA.

(c) The "HMTA" means the Hazardous Materials Transportation Act of 1974 (49 U.S.C. 1801 *et seq.*). The regulations prescribed in this part and Part 192 as they apply to "offshore gas gathering lines" are issued under the HMTA.

(d) "MTB" means the Materials Transportation Bureau which is part of the Research and Special Programs Administration, U.S. Department of Transportation.

(e) "OOE" means the Office of Operations and Enforcement, which is part of the Materials Transportation Bureau, Research and Special Programs Administration, U.S. Department of Transportation.

(f) "Region Chief" means the Chief or his designee of any one of the Regional Offices of the Office of Operations and Enforcement. Regional Offices are located in Washington, D.C. (Eastern Region); Atlanta, Georgia (Southern Region); Kansas City, Missouri (Central Region); Houston, Texas (Southwest Region); and Burlingame, California (Western Region).

(g) "Presiding Official" means the person who conducts any hearing relating to civil penalty assessments, compliance orders or hazardous facility orders.

(h) "Person" means any individual, firm, joint venture, partnership, corporation, association, State, municipality, cooperative association, or joint stock association, and includes any trustee, receiver, assignee, or personal representative thereof.

(i) "Respondent" means a person upon whom the OOE has served a notice of probable violation.

(j) "State" means a State of the United States, the District of Columbia and the Commonwealth of Puerto Rico.

(k) "Hearing" means an informal conference or a proceeding for oral presentation. Unless otherwise specifically prescribed in this part, the use of "hearing" is not intended to require a hearing on the record in accordance with section 554 of title 5, U.S.C.

§ 190.5 Service.

(a) Each order, notice, or other document required to be served under this part shall be served personally or by registered or certified mail.

(b) Service upon a person's duly authorized representative or agent constitutes service upon that person.

(c) Service by registered or certified mail is complete upon mailing. An official U. S. Postal Service receipt from the registered or certified mailing constitutes prima facie evidence of service.

§ 190.7 Subpoenas; witness fees.

(a) The Director, MTB, the Chief Counsel, Research and Special Programs Administration, or the official designated by the Director, MTB to preside over a hearing convened in accordance with this part, may sign and issue subpoenas either on his own initiative or, upon request and adequate showing by any person participating in the proceeding that the information sought will materially advance the proceeding.

(b) A subpoena may require the attendance of a witness, or the production of documentary or other tangible evidence in the possession or under the control of person served, or both.

(c) A subpoena may be served personally by any person who is not an interested person and is not less than 18 years of age, or by certified or registered mail.

(d) Service of a subpoena upon the person named therein shall be made by delivering a copy of the subpoena to such person and by tendering the fees for one day's attendance and mileage as specified by paragraph (g) of this section. When a subpoena is issued at the instance of any officer or agency of the United States, fees and mileage need not be tendered at the time of service. Delivery of a copy of a subpoena and tender of the fees to a natural person may be made by handing them to the person, leaving them at his office with the person in charge thereof, leaving them at his dwelling place or usual place of abode with some person of suitable age and discretion then residing therein, by mailing them by registered or certified mail to him at his last known address, or by any method whereby actual notice is given to him and the fees are made available prior to the return date.

(e) When the person to be served is not a natural person, delivery of a copy of the subpoena and tender of the fees may be effected by handing them to a designated agent or representative for service, or to any officer, director, or agent in charge of any office of the person, or by mailing them by registered or certified mail to that agent or representative and the fees are made available prior to the return date.

(f) The original subpoena bearing a certificate of service shall be filed with the official having responsibility for the proceeding in connection with which the subpoena was issued.

(g) A subpoenaed witness shall be paid the same fees and mileage as would be paid to a witness in a proceeding in the district courts of the United States. The witness fees and mileage shall be paid by the person at whose instance the subpoena was issued.

(h) Notwithstanding the provisions of paragraph (g) of this section, and upon request, the witness fees and mileage may be paid by the MTB if the official who issued the subpoena determines on the basis of good cause shown, that:

(1) The presence of the subpoenaed witness will materially advance the proceeding; and

(2) The person at whose instance the subpoena was issued would suffer a serious hardship if required to pay the witness fees and mileage.

(i) Any person to whom a subpoena is directed may, prior to the time specified therein for compliance, but in no event more than 10 days after the date of service of such subpoena, apply to the official who issued the subpoena, or if he is unavailable, to the Director, MTB, to quash or modify the subpoena. The application shall contain a brief statement of the reasons relied upon in support of the action sought therein. The Director, MTB, or this issuing official, as the case may be, may:

(1) Deny the application;

(2) Quash or modify the subpoena; or

(3) Condition a grant or denial of the application to quash or modify the subpoena upon the satisfaction of certain just and reasonable requirements. The denial may be summary.

(j) Upon refusal to obey a subpoena served upon any person under the provisions of this section, the MTB may request the Attorney General to seek the aid of the U. S. District Court for any District in which the person is found to compel that person, after notice, to appear and give testimony, or to appear and produce the subpoenaed documents before the MTB, or both.

Subpart B—Enforcement

§ 190.201 Purpose and scope.

(a) This subpart describes the enforcement authority and sanctions exercised by the OOE for achieving and maintaining pipeline safety. It also prescribes the procedures governing the exercise of that authority and the imposition of those sanctions.

(b) A person who is the subject of action pursuant to this subpart may be represented by legal counsel at all stages of the proceeding.

§ 190.203 Inspections.

(a) Officers, employees, or agents authorized by the Associate Director, OOE, upon presenting appropriate credentials are authorized to enter upon, inspect, and examine, at reasonable times and in a reasonable manner, the records and properties of persons to the extent such records and properties are relevant to determining the compliance of such persons with the HLPSA, NGPSA, HMTA or regulations, or orders issued thereunder.

(b) Inspections are ordinarily conducted pursuant to one of the following:

(1) Routine scheduling by the Chief of the Region in which the facility is located;

(2) A complaint received from a member of the public;

(3) Information obtained from a previous inspection;

(4) Report from a State agency participating in the Federal program under section 5 of the NGPSA or section 205 of the HLPSA;

(5) Pipeline accident or incident; or

(6) Whenever deemed appropriate by the Director, MTB or his designee.

(c) If, after an inspection, the OOE believes that further information is needed to determine appropriate action, OOE may send the owner or operator a "Request for Specific Information" to be answered within 30 days after receipt of the letter.

(d) To the extent necessary to carry out his responsibilities under the HLPSA, HMTA or the NGPSA, the Director, MTB may require testing of portions of pipeline facilities subject to those Acts which have been involved in or affected by an accident. However, before exercising such authority, the Director, MTB shall make every effort to negotiate a mutually acceptable plan with the owner of such facilities and, where appropriate, the National Transportation Safety Board for performing such testing.

(e) When the information obtained from an inspection or from other appropriate sources indicates that further OOE action is warranted, the OOE issues a warning letter under § 190.205 or initiates one or more of the enforcement proceedings prescribed in §§ 190.207 through 190.235.

§ 190.205 Warning letters.

Upon determining that a probable violation of the NGPSA, HLPSA, or HMTA or any regulation or order issued under any of those Acts has occurred, the OOE may issue a Warning Letter notifying the owner or operator of the probable violation and advising him to correct it or be subject to enforcement action under §§ 190.207 through 190.235.

§ 190.207 Notice of probable violation.

(a) Except as otherwise provided by this subpart, a Region Chief begins an enforcement proceeding by serving a notice of probable violation on a person charging him with a probable violation of the NGPSA, HLPSA, or HMTA or any regulation or order issued thereunder.

(b) A notice of probable violation issued under this section shall include:

(1) Statement of the provisions of the laws, regulations or orders which the respondent is alleged to have violated and a statement of the evidence upon which the allegations are based;

(2) Notice of response options available to the respondent under § 190.209;

(3) If a civil penalty is proposed under § 190.221, the amount of the proposed civil penalty and the maximum civil penalty for which respondent is liable under law; and

(4) If a compliance order is proposed under § 190.217, a statement of the remedial action being sought in the form of a proposed compliance order.

(c) OOE may amend a notice of probable violation at any time prior to issuance of a final order under § 190.213. If an amendment includes any new material allegations of fact or proposes an increased civil penalty amount or new or additional remedial action under § 190.217, the respondent shall have the opportunity to respond under § 190.209.

§ 190.209 Response options.

Within 30 days of his receipt of a notice of probable violation the respondent shall respond to the Region Chief who issued the Notice in the following way:

(a) When the notice contains a proposed civil penalty—

(1) Pay the proposed civil penalty as provided in § 190.227 and close the case;

(2) Submit an offer in compromise of the proposed civil penalty under paragraph (c) of this section and paragraph (a) of § 190.227;

(3) Submit written explanations, information or other materials in answer to the allegations or in mitigation of the proposed civil penalty; or

(4) Request a hearing under § 190.211.

(b) When the notice contains a proposed compliance order—

(1) Agree to the proposed compliance order;

(2) Request the execution of a consent order under § 190.219;

(3) Object to the proposed compliance order and submit written explanations, information or other materials in answer to the allegations in the notice of probable violation; or

(4) Request a hearing under § 190.211.

(c) An offer in compromise under paragraph (a) of this section is made by submitting a check or money order for the amount offered to the Region Chief who forwards the offer to the Associate Director, OOE, for action. If the offer in compromise is accepted by the Associate Director, OOE, the respondent is notified in writing that the acceptance is in full settlement of the civil penalty action. If an offer in compromise submitted under paragraph (a) of this section is rejected by OOE, it is returned to the respondent with written notification. Within 10 days of his receipt of such notification, the respondent shall again respond to the Region Chief in one or more of the ways provided in paragraph (a) of this section.

(d) Failure of the respondent to respond in accordance with paragraph (a) of this section or, when applicable, paragraph (c) of this section, constitutes a waiver of his right to contest the allegations in the notice of probable violation and authorizes the Associate Director, OOE, without further notice to the respondent, to find facts to be as alleged in the notice of probable violation and to issue a final order under § 190.213.

§ 190.211 Hearing.

(a) A request for a hearing in response to a notice of probable violation issued under § 190.207 must be accompanied by a statement of the issues which the respondent intends to raise at the hearing. The issues may relate to the alleged violations, new information or to the proposed compliance order or proposed civil penalty amount. A respondent's failure to specify an issue may result in waiver of his right to raise that issue at the hearing. The respondent's request must also indicate whether or not he will be represented by counsel at the hearing.

(b) In such circumstances as deemed appropriate by the Region Chief, and only if the respondent concurs, a telephone conference may be held in lieu of a hearing.

(c) If the respondent contests any of the alleged violations, if the respondent is represented by counsel or if the respondent specifically requests that an attorney conduct the hearing, an attorney from the Office of the Chief Counsel, Research and Special Programs Administration, serves as the presiding official at the hearing. Otherwise, the hearing may be conducted by a representative of the OOE Region in which the facility is located.

(d) The hearing is conducted informally without strict adherence to rules of evidence. The respondent may submit any relevant information and material and call witnesses on his behalf. He also may examine the evidence and witnesses against him. No detailed record of a hearing is prepared.

(e) At the outset of the hearing, the material in the case file pertinent to the issues to be determined is presented by the presiding official. The respondent may examine and respond to or rebut this material.

(f) After the presentation of the material in the case file, the respondent may offer any facts, statements, explanations, documents, testimony or other items which are relevant to the issues under consideration.

(g) At the close of the respondent's presentation, the presiding official may present or allow the presentation of any OOE rebuttal information. The respondent may then respond to that information.

(h) After the evidence in the case has been presented, the presiding official shall permit argument on the issues under consideration.

(i) The respondent may also request an opportunity to submit further written materal for inclusion in the case file. The presiding official shall allow a reasonable time for the submission of the material and shall specify the date by which it must be submitted. If the material is not submitted within the time prescribed, the case shall proceed to final action without the material.

(j) After submission of all materials during and after the hearing, the presiding official shall prepare a written recommendation as to final action in the case. This recommendation, along with any material submitted during and after the hearing, shall be included in the case file which is forwarded to the Associate Director, OOE, for final administrative action.

§ 190.213 Final order.

(a) After a hearing under § 190.211 or, if no hearing has been held, after expiration of the 30 day response period prescribed in § 190.209, the case file of an enforcement proceeding commenced under § 190.207 is forwarded to the Associate Director, OOE, for issuance of a final order.

(b) The case file of an enforcement proceeding commenced under § 190.207 includes—

(1) The inspection reports and any other evidence of alleged violations;

(2) A copy of the notice of probable violation issued under § 190.207;

(3) Material submitted by the respondent in accord with § 190.209 in response to the notice of probable violation;

(4) The Region Chief's evaluation of response material submitted by the respondent and his recommendation for final action to be taken under this section; and

(5) In cases involving a § 190.211 hearing, any material submitted during and after the hearing and the presiding official's recommendation for final action to be taken under this section.

(c) Based on his review of a case file described in paragraph (b) of this section, the Associate Director, OOE, shall issue a final order that includes—

(1) A statement of findings and determinations on all material issues, including a determination as to whether each alleged violation has been proved;

(2) If a civil penalty is assessed, the amount of the penalty and the procedures for payment of the penalty, provided that the assessed civil penalty may not exceed the penalty proposed in the notice of probable violation; and

(3) If a compliance order is issued, a statement of the actions required to be taken by the respondent and the time by which such actions must be accomplished.

(d) Except as provided by § 190.215, an order issued under this section regarding an enforcement proceeding is considered final administrative action on that enforcement proceeding.

(e) It is the policy of the Associate Director, OOE, to issue a final order under this section within 45 days of receipt of the case file, unless it is found impracticable to take action within that time. In cases where it is so found and the delay beyond that period is expected to be substantial, notice of that fact and the date by which it is expected that action will be taken is issued to the respondent.

§ 190.215 Petitions for reconsideration.

(a) A respondent may petition the Associate Director, OOE, for reconsideration of a final order issued under § 190.213. It is requested, but not required, that three copies be submitted. The petition must be received no later than 20 days after service upon the respondent of the final order. Petitions received after that time will not be considered. The petition must contain a brief statement of the complaint and an explanation as to why the effectiveness of the final order should be stayed.

(b) If the respondent requests the consideration of additional facts or arguments he must state the reasons they were not presented prior to issuance of the final order.

(c) The Associate Director, OOE, does not consider repetitious information, arguments, or petitions.

(d) Unless the Associate Director, OOE, otherwise provides, the filing of a petition under this section does not stay the effectiveness of the final order.

(e) The Associate Director, OOE, may grant or deny, in whole or in part, any petition for reconsideration without further proceedings. In the event he determines to reconsider a final order, he may issue a final decision on reconsideration without further proceedings, or he may provide such opportunity to submit comment or information and data as he deems appropriate.

(f) It is the policy of the Associate Director, OOE, to issue notice of the action taken on a petition for reconsideration within 20 days after receipt of the petition, unless it is found impracticable to take action within that time. In cases where it is so found and delay beyond that period is expected to be substantial, notice of that fact and the date by which it is expected that action will be taken is issued to the respondent.

COMPLIANCE ORDERS

§ 190.217 Compliance orders generally.

When the OOE has reason to believe that a person is engaging in conduct which involves a violation of the NGPSA, HMTA or the HLPSA or any regulation issued under any of those Acts, and if the nature of the violation, and the public interest warrant, the OOE may conduct proceedings under §§ 190.207 through 190.213 of this part to determine the nature and extent of the violations and to issue an order directing compliance.

§ 190.219 Consent order.

(a) At any time before the issuance of a compliance order under § 190.213 the Associate Director, OOE, and the respondent may agree to dispose of the case by joint execution of a consent order. Upon such joint execution, the consent order shall be considered a final order under § 190.213.

(b) A consent order executed under paragraph (a) of this section shall include:

(1) An admission by the respondent of all jurisdictional facts;

(2) An express waiver of further procedural steps and of all right to seek judicial review or otherwise challenge or contest the validity of that order;

(3) An acknowledgement that the notice of probable violation may be used to construe the terms of the consent order; and

(4) A statement of the actions required of the respondent and the time by which such actions shall be accomplished.

CIVIL PENALTIES

§ 190.221 Civil penalities generally.

When the OOE has reason to believe that a person has committed an act which is a violation of any provision of the NGPSA, HMTA or the HLPSA or any regulation or order issued under any of those Acts, it may conduct proceedings under §§ 190.207 through 190.213 to determine the nature and extent of the violations and to assess and, if appropriate, compromise a civil penalty.

§ 190.223 Maximum penalties.

(a) Any person who violates a provision of the NGPSA or the HLPSA or any regulation or order issued under either of those Acts, is subject to a civil penalty not to exceed $1,000 for each violation for each day the violation continues except that the maximum civil penalty may not exceed $200,000 for any related series of violations.

(b) Any person who knowingly violates a regulation or order under this subchapter applicable to offshore gas gathering lines issued under the authority of the HMTA is liable for a civil penalty of not more than $10,000 for each violation, and if any such violation is a continuing one, each day of violation constitutes a separate offense.

(c) Any person who is determined to have violated any standard or order under section 6 or 7(b) of the NGPSA shall be subject to a civil penalty of not to exceed $50,000, which penalty shall be in addition to any other penalties to which such person may be subject under paragraph (a) of this section.

(d) No person shall be subject to a civil penalty under this section for the violation of any requirement of this subchapter and an order issued under § 190.217, § 190.219 or § 190.233 if both violations are based on the same act.

§ 190.225 Assessment considerations.

The Associate Director, OOE, assesses a civil penalty under this part only after considering:

(a) The nature, circumstances and gravity of the violation;

(b) The degree of the respondent's culpability;

(c) The respondent's history of prior offenses;

(d) The respondent's ability to pay;

(e) Any good faith by the respondent in attempting to achieve compliance;

(f) The effect on the respondent's ability to continue in business; and

(g) Such other matters as justice may require.

§ 190.227 Payment of penalty.

(a) Payment by a respondent of a civil penalty proposed, assessed, or compromised under this subpart must be made by certified check or money order payable to the Treasury of the United States. Except as provided by § 190.209, such payment is sent to the Office of the Chief Counsel (DCC-1), Research and Special Programs Administration, Department of Transportation, Washington, D.C. 20590.

(b) If a respondent fails to pay the full amount of a civil penalty assessed in a final order issued under § 190.213 or make an offer in compromise to the assessed penalty as provided by paragraph (c) of this section within 20 days after receipt of the final order, the Chief Counsel may refer the case to the Attorney General with a request that an action to collect the assessed penalty be brought in the appropriate United States district court or the Federal magistrate court within that district to the extent permitted under 28 U.S.C. 636.

(c) Within 20 days after the respondent's receipt of a final order assessing a civil penalty issued under § 190.213, the respondent may offer to compromise the assessed penalty by submitting, in the manner required by paragraph (a) of this section, payment in the amount offered. The Chief Counsel or his designee may accept or reject the compromise offer on behalf of the Associated Director, OOE. If it is accepted, the respondent is notified in writing that the acceptance is in full settlement of the civil penalty action. If the compromise offer is rejected it will be returned to the respondent with written notification. Within 20 days after the respondent's receipt of such notification, payment of the full amount of the civil penalty assessed in the final order becomes due. The provisions of paragraph (b) of this section regarding district court or Federal magistrate court action for penalty collection apply upon failure of the respondent to pay the assessed penalty within that time period.

(d) If the respondent elects to make an offer in compromise to a civil penalty proposed in a notice of probable violation issued under § 190.207, he shall do so in accord with the procedures of § 190.209.

CRIMINAL PENALTIES

§ 190.229 Criminal penalties generally.

(a) Any person who willfully and knowingly violates a provision of the NGPSA or the HLPSA or any regulation or order issued thereunder shall upon conviction be subject for each offense to a fine of not more than $25,000 and imprisonment for not more than five years, or both.

(b) Any person who willfully violates a regulation or order under this subchapter issued under the authority of the HMTA applicable to offshore gas gathering lines shall upon conviction be subject for each offense to a fine of not more than $25,000, imprisonment for a term not to exceed 5 years, or both.

(c) Any person who willfully and knowingly injures or destroys, or attempts to injure or destroy, any interstate transmission facility (as that term is defined in the NGPSA) or any interstate pipeline facility (as that term is defined in the HLPSA) shall, upon conviction, be subject, for each offense, to a fine of not more than $25,000, imprisonment for a term not to exceed 15 years, or both.

(d) No person shall be subject to criminal penalties under paragraph (a) of this section for violation of any regulation and the violation of any order issued under § 190.217, § 190.219 or § 190.229 if both violations are based on the same act.

§ 190.231 Referral for prosecution.

If an employee of MTB becomes aware of any actual or possible activity subject to criminal penalties under § 190.229, he reports it to the Office of the Chief Counsel, Research and Special Programs Administration, U.S. Department of Transportation, Washington, D.C. 20590. The Chief Counsel refers the report to OOE for investigation. Upon completion of the investigation and if appropriate, the Chief Counsel or his designee refers the report to the Department of Justice for criminal prosecution of the offender.

SPECIFIC RELIEF

§ 190.233 Hazardous facility orders.

(a) Except as provided by paragraph (b) of this section, if the Associate Director, OOE, finds, after reasonable notice and opportunity for hearing in accord with paragraph (c) of this section, a particular pipeline facility to be hazardous to life or property, he shall issue an order pursuant to this section requiring the owner or operator of the facility to take corrective action. Corrective action may include suspended or restricted use of the facility, physical inspection, testing, repair, replacement, or other action, as appropriate.

(b) The Associate Director, OOE, may waive the requirement for notice and hearing under paragraph (a) of this section before issuing an order pursuant to this section when he determines that the failure to do so would result in the likelihood of serious harm to life or property. However, he shall include in the order an opportunity for hearing as soon as practicable after issuance of the order. The provisions of paragraph (c)(2) of this section apply to an owner or operator's decision to exercise such an opportunity for hearing. The purpose of such a post-order hearing is for the Associate Director, OOE, to determine whether the order should remain in effect or be rescinded or suspended in accord with paragraph (g) of this section.

(c) Notice and hearing:

(1) Written notice that OOE intends to issue an order under this section shall be served in accordance with § 190.5, upon the owner or operator of an alleged hazardous facility. The notice shall allege the existence of a hazardous facility, stating the facts and circumstances supporting the issuance of a "hazardous facility order", and providing the owner or operator an opportunity for a hearing, identifying the time and location of the hearing.

(2) An owner or operator elects to exercise his opportunity for a hearing under this section, by notifying the OOE of that election in writing within 10 days of service of the notice provided under paragraph (c)(1) of this section or when applicable, under paragraph (b) of this section.

Absence of such written notification waives an owner or operator's opportunity for a hearing and allows the Associate Director, OOE, to proceed to issue a "hazardous facility order" in accordance with paragraphs (d) through (h) of this section.

(3) A hearing under this section shall be presided over by an attorney from the Office of Chief Counsel, Research and Special Programs Administration, acting as Presiding Official, and conducted without strict adherence to rules of evidence. The Presiding Official presents the allegations contained in the notice issued under this section. The owner or operator of the alleged hazardous facility may submit any relevant information or materials, call witnesses and present arguments on the issue of whether or not a "hazardous facility order" should be issued.

(4) Within 48 hours after conclusion of a hearing under this section, the Presiding Official shall submit a recommendation to the Associate Director, OOE, as to whether or not a "hazardous facility order" is required. Upon receipt of the recommendation, the Associate Director, OOE, shall proceed in accordance with paragraphs (d) through (h) of this section. If the Associate Director, OOE, finds the facility to be hazardous to life or property he shall issue an order in accordance with this section. If he does not find the facility to be hazardous to life or property, the Associate Director, OOE, shall dismiss the allegations contained in the notice, and promptly notify the owner or operator in writing by service as prescribed in § 190.5.

(d) The Associate Director, OOE, may find a pipeline facility to be hazardous under paragraph (a) of this section—

(1) If under the facts and circumstances he determines the particular facility is hazardous to life or property; or

(2) If the pipeline facility or a component thereof has been constructed or operated with any equipment, material, or technique which he determines is hazardous to life or property, unless the operator involved demonstrates to the satisfaction of the OOE that, under the particular facts and circumstances involved, such equipment, material, or technique is not hazardous to life or property.

(e) In making a determination under paragraph (d) of this section, the Associate Director, OOE, shall consider, if relevant—

(1) The characteristics of the pipe and other equipment used in the pipeline facility involved, including its age, manufacturer, physical properties including its age, manufacturer, physical properties (including its resistance to corrosion and deterioration), and the method of its manufacture, construction or assembly;

(2) The nature of the materials transported by such facility (including their corrosive and deteriorative qualities), the sequence in which such materials are transported, and the pressure required for such transportation;

(3) The aspects of the areas in which the pipeline facility is located, in particular the climatic and geologic condi-

tions (including soil characteristics) associated with such areas, and the population density and population and growth patterns of such areas;

(4) Any recommendation of the National Transportation Safety Board issued in connection with any investigation conducted by the Board; and

(5) Such other factors as the Associate Director, OOE, may consider appropriate.

(f) The order shall contain the following information:

(1) A finding that the pipeline facility is hazardous to life or property.

(2) The relevant facts which form the basis for that finding.

(3) The legal basis for the order.

(4) The nature and description of particular corrective action required of the respondent.

(5) The date by which the required action must be taken, or completed and, where appropriate, the duration of the order.

(6) If a hearing has been waived pursuant to paragraph (b) of this section, a statement that an opportunity for a hearing is provided at a particular location and at a certain time after issuance of the order.

(g) The Associate Director, OOE, shall rescind or suspend a "hazardous facility order" whenever he determines that the facility is no longer hazardous to life or property. When appropriate, however, such a recision or suspension may be accompanied by a notice of probable violation issued under § 190.207.

(h) At any time after an order issued under this section has become effective, the Associate Director, OOE, may request the Attorney General to bring an action for appropriate relief in accordance with § 190.235.

(i) Upon petition by the Attorney General, the District Courts of the United States shall have jurisdiction, to enforce orders issued under this section by appropriate means.

§ 190.235 Injunctive action.

Whenever it appears to OOE that a person has engaged, is engaged, or is about to engage in any act or practice constituting a violation of any provision of the NGPSA, the HLPSA or the HMTA, or any regulations issued under any of those Acts, the Director, MTB, or his delegate, may request the Attorney General to bring an action in the appropriate U.S. District Court for such relief as is necessary or appropriate, including mandatory of prohibitive injunctive relief, interim equitable relief, and punitive damages as provided by section 12(a) of the NGPSA, section 209(a) of the HLPSA and section 111(a) of the HMTA.

PART 191—TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE; REPORTS OF LEAKS

Sec.

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AUTHORITY: 49 U.S.C. 1671 et seq.; 49 CFR Part 1; 33 FR 16468, unless otherwise noted.

SOURCE: 35 FR 320, Jan. 8, 1970, unless otherwise noted.

§ 191.1 Scope.

(a) This part prescribes requirements for the reporting of gas leaks that are not intended by the operator and that require immediate or scheduled repair and of test failures, by persons engaged in the transportation of gas. However, it does not apply to leaks and test failures that occur in the gathering of gas outside of the following areas:

(1) An area within the limits of any incorporated or unincorporated city, town, or village; or

(2) Any designated residential or commercial area such as a subdivision, business or shopping center, or community development.

(b) The reporting requirements in this part supersede any accident or leak reporting requirements that were incorporated by reference in the Interim Minimum Federal Safety Standards in Part 190 of this chapter.

§ 191.3 Definitions.

As used in this part and in the DOT Forms referenced in this part—

"Gas" means natural gas, flammable gas, or gas which is toxic or corrosive;

"Municipality" means a city, county, or any other political subdivision of a State;

"Operator" means a person who engages in the transportation of gas;

"Person" means any individual, firm, joint venture, partnership, corporation, association, State, municipality, cooperative association, or joint stock association, and includes any trustee, receiver, assignee, or personal representative thereof;

"Pipeline facilities" includes, without limitation, new and existing pipe, right-of-way, and any equipment facility, or building used in the transportation of gas or the treatment of gas during the course of transportation;

"Secretary" means the Secretary of Transportation or any person to whom he has delegated authority in the matter concerned;

"State" includes each of the several States, the District of Columbia, and the Commonwealth of Puerto Rico;

"System" means all pipeline facilities used by a particular operator in the transportation of gas, including but not limited to, line pipe, valves and other appurtenances connected to line pipe, compressor units, fabricated assemblies associated with compressor units, metering (including customers' meters) and delivery stations, and fabricated assemblies in metering and delivery stations;

"Test failure" means a break or rupture that occurs during strength-proof testing of transmission or gathering lines that is of such magnitude as to require repair before continuation of the test;

"Transportation of gas" means the gathering, transmission, or distribution of gas by pipeline, or the storage of gas in or affecting interstate or foreign commerce.

§ 191.5 Telephonic notice of certain leaks.

(a) At the earliest practicable moment following discovery, each operator shall give notice in accordance with paragraph (b) of this section of any leak that—

(1) Caused a death or a personal injury requiring hospitalization;

(2) Required the taking of any segment of transmission pipeline out of service;

(3) Resulted in gas igniting;

(4) Caused estimated damage to the property of the operator, or others, or both, of a total of $5,000 or more; or

(5) In the judgment of the operator, was significant even though it did not meet the criteria of paragraphs (a)(1), (2), (3), or (4) of this section.

An operator need not give notice of a leak that met only the criteria of paragraph (a) (2) or (3) of this paragraph, if it occurred solely as a result of, or in connection with, planned or routine maintenance or construction.

(b) Each notice required by paragraph (a) of this section shall be made by telephone to area code (202) 426-0700 and shall include the following information.

(1) The location of the leak.

(2) The time of the leak.

(3) The fatalities and personal injuries, if any.

(4) All other significant facts that are known by the operator that are relevant to the cause of the leak or extent of the damages.

[35 FR 320, Jan. 8, 1970, as amended by Amdt. 191-1, 36 FR 7507, Apr. 2, 1971]

§ 191.7 Addressee for written reports.

Each written report required by this part must be made to the Chief, Information Systems Division, Transportation Programs Bureau, Department of Transportation, Washington, D.C. 20590. However, reports for intrastate facilities subject to the jurisdiction of a State agency pursuant to certification under section 5(a) of the Natural Gas Pipeline Safety Act, may be submitted in duplicate to the State agency if the regulations of that agency require submission of these reports and provide for further transmittal of one copy, within 10 days of receipt for leak reports and not later than February 15 for annual reports, to the Chief, Information Systems Division, Transportation Programs Bureau.

[35 FR 320, Jan. 8, 1970, as amended by Amdt. 191-3, 46 FR 37251, July 20, 1981]

§ 191.9 Distribution system: Leak report.

(a) Each operator of a distribution system serving more than 100,000 customers shall, as soon as practicable but not more than 20 days after detection, report the following on Department of Transportation Form DOT-F-7100.1:

(1) A leak that required notice by telephone under § 191.5.

(2) A leak that, because of its location, required immediate repair and other emergency action to protect the public such as evacuation of a building, blocking off an area, or rerouting of traffic.

(b) Where additional related information is obtained after a report is submitted under paragraph (a) of this section, the operator shall make a supplemental report as soon as practicable with a clear reference by date and subject to the original report.

[35 FR 320, Jan. 8, 1970, as amended by Amdt. 191-3, 46 FR 37251, July 20, 1981]

§ 191.11 Distribution system: Annual report.

(a) Except as provided in paragraph (b) of this section, each operator of a distribution system shall submit an annual report on Department of Transportation Form DOT F 7100.1-1. This report must be submitted not later than February 15 for the preceding calendar year.

(b) The annual report required by paragraph (a) of this section need not be submitted with respect to petroleum gas systems which serve less than 100 customers from a single source.

[Amdt. 191-2, 37 FR 1173, Jan. 26, 1972]

§ 191.13 Distribution system: Certain facilities reported as a transmission system.

Each operator of a distribution system shall, for pipeline facilities that operate at 20 percent or more of specified minimum yield strength, or that are used to convey gas into or out of storage, submit reports for those facilities under § 191.15 and § 191.17.

§ 191.15 Transmission and gathering systems: Leak report.

(a) Each operator of a transmission system or a gathering system shall, as soon as practicable but not more than 20 days after detection, report the following on Department of Transportation Form DOT-F-7100.2:

(1) A leak that required notice by telephone under § 191.5.

(2) A leak in a transmission line that required immediate repair.

(3) A test failure that occurred while testing either with gas or another test medium.

(b) Where additional related information is obtained after a report is submitted under paragraph (a) of this section, the operator shall make a supplemental report as soon as practicable with a clear reference by date and subject to the original report.

§ 191.17 Transmission and gathering systems: Annual report.

Each operator of a transmission system or a gathering system shall submit an annual report on Department of Transportation Form DOT-F-7100.2-1. This report must be submitted for the preceding calendar year not later than February 15, 1971, and not later than February 15 of each year thereafter.

§ 191.19 Report forms.

Copies of the prescribed report forms are available without charge upon request from the address given in § 191.7. Additional copies in this prescribed format may be reproduced and used if in the same size and kind of paper. In addition, the information required by these forms may be submitted by any other means that is acceptable to the Secretary.

[35 FR 320, Jan. 8, 1970, as amended by Amdt. 191-3, 46 FR 37251, July 20, 1981]

NOTE: The recordkeeping and reporting requirements of this regulation have been approved by the Office of Management and Budget in accordance with the Federal Reports Act of 1942.

PART 192—TRANSPORTATION OF NATURAL AND OTHER GAS BY PIPELINE: MINIMUM FEDERAL SAFETY STANDARDS

Subpart A—General

Sec.

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APPENDIX D—CRITERIA FOR CATHODIC PROTECTION AND DETERMINATION OF MEASUREMENTS

AUTHORITY: Sec. 3, Pub. L. 90-481, 82 Stat. 721 (49 U.S.C. 1672); sections applicable to offshore gathering lines also issued under Sec. 105, Pub. L. 93-633, 88 Stat. 2157 (49 U.S.C. 1804); 40 FR 43901, 49 CFR 1.53; unless otherwise noted.

SOURCE: 35 FR 13257, Aug. 19, 1970, unless otherwise noted.

Subpart A—General

§ 192.1 Scope of part.

(a) This part prescribes minimum safety requirements for pipeline facilities and the transportation of gas, including pipeline facilities and the transportation of gas within the limits of the outer continental shelf as that term is defined in the Outer Continental Shelf Lands Act (43 U.S.C. 1331).

(b) This part does not apply to—

(1) Offshore gathering of gas upstream from the outlet flange of each facility on the outer continental shelf where hydrocarbons are produced or where produced hydrocarbons are first separated, dehydrated, or otherwise processed, whichever facility is farther downstream; and

(2) Onshore gathering of gas outside of the following areas:

(i) An area within the limits of any incorporated or unincorporated city, town, or village.

(ii) Any designated residential or commercial area such as a subdivision, business or shopping center, or community development.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976]

§ 192.3 Definitions.

As used in this part—

"Distribution Line" means a pipeline other than a gathering or transmission line.

"Gas" means natural gas, flammable gas, or gas which is toxic or corrosive.

"Gathering Line" means a pipeline that transports gas from a current production facility to a transmission line or main.

"High pressure distribution system" means a distribution system in which the gas pressure in the main is higher than the pressure provided to the customer.

"Listed specification" means a specification listed in section I of Appendix B of this part.

"Low-pressure distribution system" means a distribution system in which the gas pressure in the main is substantially the same as the pressure provided to the customer.

"Main" means a distribution line that serves as a common source of supply for more than one service line.

"Maximum actual operating pressure" means the maximum pressure that occurs during normal operations over a period of 1 year.

"Maximum allowable operating pressure" means the maximum pressure at which a pipeline or segment of a pipeline may be operated under this part.

"Municipality" means a city, county, or any other political subdivision of a State.

"Offshore" means beyond the line of ordinary low water along that portion of the coast of the United States that is in direct contact with the open seas and beyond the line marking the seaward limit of inland waters.

"Operator" means a person who engages in the transportation of gas.

"Person" means any individual, firm, joint venture, partnership, corporation, association, State, municipality, cooperative association, or joint stock association, and including any trustee, receiver, assignee, or personal representative thereof.

"Pipe" means any pipe or tubing used in the transportation of gas, including pipe-type holders.

"Pipeline" means all parts of those physical facilities through which gas moves in transportation, including pipe, valves, and other appurtenance attached to pipe, compressor units, metering stations, regulator stations, delivery stations, holders, and fabricated assemblies.

"Pipeline facility" means new and existing pipelines, rights-of-way, and any equipment, facility, or building used in the transportation of gas or in the treatment of gas during the course of transportation.

"Secretary" means the Secretary of Transportation or any person to whom he has delegated authority in the matter concerned.

"Service line" means a distribution line that transports gas from a common source of supply to (a) a customer meter or the connection to a customer's piping, whichever is farther downstream, or (b) the connection to a customer's piping if there is no customer meter. A customer meter is the meter that measures the transfer of gas from an operator to a consumer.

"SMYS" means specified minimum yield strength is—

(a) For steel pipe manufactured in accordance with a listed specification, the yield strength specified as a minimum in that specification; or

(b) For steel pipe manufactured in accordance with an unknown or unlisted specification, the yield strength determined in accordance with § 192.107(b).

"State" means each of the several States, the District of Columbia, and the Commonwealth of Puerto Rico.

"Transmission line" means a pipeline, other than a gathering line, that—

(a) Transports gas from a gathering line or storage facility to a distribution center or storage facility;

(b) Operates at a hoop stress of 20 percent or more of SMYS; or

(c) Transports gas within a storage field.

"Transportation of gas" means the gathering, transmission, or distribution of gas by pipeline or the storage of gas, in or affecting interstate or foreign commerce.

[Amdt. 192-13, 38 FR 9084, Apr. 10, 1973, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976]

§ 192.5 Class locations.

(a) Offshore is Class 1 location. The Class location onshore is determined by applying the criteria set forth in this section: The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline. Except as provided in paragraphs (d)(2) and (f) of this section, the class location is determined by the buildings in the class location unit. For the purposes of this section, each separate dwelling unit in a multiple dwelling unit building is counted as a separate building intended for human occupancy.

(b) A Class 1 location is any class location unit that has 10 or less buildings intended for human occupancy.

(c) A Class 2 location is any class location unit that has more than 10 but less than 46 buildings intended for human occupancy.

(d) A Class 3 location is—

(1) Any class location unit that has 46 or more buildings intended for human occupancy; or

(2) An area where the pipeline lies within 100 yards of any of the following:

(i) A building that is occupied by 20 or more persons during normal use.

(ii) A small, well-defined outside area that is occupied by 20 or more persons during normal use, such as a playground, recreation area, outdoor theater, or other place of public assembly.

(e) A Class 4 location is any class location unit where buildings with four or more stories above ground are prevalent.

(f) The boundaries of the class locations determined in accordance with paragraphs (a) through (e) of this section may be adjusted as follows:

(1) A Class 4 location ends 220 yards from the nearest building with four or more stories above ground.

(2) When a cluster of buildings intended for human occupancy requires a Class 3 location, the Class 3 location ends 220 yards from the nearest building in the cluster.

(3) When a cluster of buildings intended for human occupancy requires a Class 2 location, the Class 2 location ends 220 yards from the nearest building in the cluster.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976]

§ 192.7 Incorporation by reference.

(a) Any documents or parts thereof incorporated by reference in this part are a part of this regulation as though set out in full.

(b) All incorporated documents are available for inspection in the Materials Transportation Bureau, Washington, D.C., and at the Office of the Federal Register, 1100 L Street, N.W., Washington, D.C. These materials have been approved for incorporation by reference by the Director of the Federal Register. In addition, the documents are available at the addresses provided in Appendix A to this part.

(c) The full titles for the publications incorporated by reference in this part are provided in Appendix A to this part. Numbers in parentheses indicate applicable editions. Earlier editions of documents listed in previous editions of Appendix A may be used for materials and components manufactured, designed, or installed in accordance with those earlier editions at the time they were listed. The user must refer to the appropriate previous edition of 49 CFR for a listing of the earlier listed editions.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10159, Feb. 2, 1981]

§ 192.9 Gathering lines.

Each gathering line must comply with the requirements of this part applicable to transmission lines.

§ 192.11 Petroleum gas systems.

(a) No operator may transport petroleum gas in a system that serves 10 or more customers, or in a system, any portion of which is located in a public place (such as a highway), unless that system meets the requirements of this part and of NFPA Standards No. 58 and No. 59. In the event of a conflict, the requirements of this part prevail.

(b) Each petroleum gas system covered by paragraph (a) of this section must comply with the following:

(1) Aboveground structures must have open vents near the floor level.

(2) Belowground structures must have forced ventilation that will prevent any accumulation of gas.

(3) Relief valve discharge vents must be located so as to prevent any accumulation of gas at or below ground level.

(4) Special precautions must be taken to provide adequate ventilation where excavations are made to repair an underground system.

(c) For the purpose of this section, petroleum gas means propane, butane, or mixtures of these gases, other than a gas air mixture that is used to supplement supplies in a natural gas distribution system.

§ 192.13 General.

(a) No person may operate a segment of pipeline that is readied for service after March 12, 1971, or in the case of an offshore gathering line, after July 31, 1977, unless—

(1) The pipeline has been designed, installed, constructed; initially inspected, and initially tested in accordance with this part; or

(2) The pipeline qualifies for use under this part in accordance with § 192.14.

(b) No person may operate a segment of pipeline that is replaced, relocated, or otherwise changed after November 12, 1970, or in the case of an offshore gathering line, after July 31, 1977, unless that replacement, relocation, or change has been made in accordance with this part.

(c) Each operator shall maintain, modify as appropriate, and follow the plans, procedures, and programs that it is required to establish under this part.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976; Amdt. 192-30, 42 FR 60148, Nov. 25, 1977]

§ 192.14 Conversion to service subject to this part.

(a) A steel pipeline previously used in service not subject to this part qualifies for use under this part if the operator prepares and follows a written procedure to carry out the following requirements:

(1) The design, construction, operation, and maintenance history of the pipeline must be reviewed and, where sufficient historical records are not available, appropriate tests must be performed to determine if the pipeline is in a satisfactory condition for safe operation.

(2) The pipeline right-of-way, all aboveground segments of the pipeline, and appropriately selected underground segments must be visually inspected for physical defects and operating conditions which reasonably could be expected to impair the strength or tightness of the pipeline.

(3) All known unsafe defects and conditions must be corrected in accordance with this part.

(4) The pipeline must be tested in accordance with Subpart J of this part to substantiate the maximum allowable operating pressure permitted by Subpart L of this part.

(b) Each operator must keep for the life of the pipeline a record of the investigations, tests, repairs, replacements, and alterations made under the requirements of paragraph (a) of this section.

[Amdt. 192-30, 42 FR 60148, Nov. 25, 1977]

§ 192.15 Rules of regulatory construction.

(a) As used in this part—

"Includes" means including but not limited to.

"May" means "is permitted to" or "is authorized to".

"May not" means "is not permitted to" or "is not authorized to".

"Shall" is used in the mandatory and imperative sense.

(b) In this part—

(1) Words importing the singular include the plural;

(2) Words importing the plural include the singular; and

(3) Words importing the masculine gender include the feminine.

Subpart B—Materials

§ 192.51 Scope.

This subpart prescribes minimum requirements for the selection and qualification of pipe and components for use in pipelines.

§ 192.53 General.

Materials for pipe and components must be—

(a) Able to maintain the structural integrity of the pipeline under temperature and other environmental conditions that may be anticipated;

(b) Chemically compatible with any gas that they transport and with any other material in the pipeline with which they are in contact; and

(c) Qualified in accordance with the applicable requirements of this subpart.

§ 192.55 Steel pipe.

(a) New steel pipe is qualified for use under this part if—

(1) It was manufactured in accordance with a listed specification;

(2) It meets the requirements of—

(i) Section II of Appendix B to this part; or

(ii) If it was manufactured before November 12, 1970, either section II or III of Appendix B to this part; or

(3) It is used in accordance with paragraph (c) or (d) of this section.

(b) Used steel pipe is qualified for use under this part if—

(1) It was manufactured in accordance with a listed specification and it meets the requirements of paragraph II-C of Appendix B to this part;

(2) It meets the requirements of—

(i) Section II of Appendix B to this part; or

(ii) If it was manufactured before November 12, 1970, either section II or III of Appendix B to this part;

(3) It has been used in an existing line of the same or higher pressure and meets the requirements of paragraph II-C of Appendix B to this part; or

(4) It is used in accordance with paragraph (c) of this section.

(c) New or used steel pipe may be used at a pressure resulting in a hoop stress of less than 6,000 p.s.i. where no close coiling or close bending is to be done, if visual examination indicates that the pipe is in good condition and that it is free of split seams and other defects that would cause leakage. If it is to be welded, steel pipe that has not been manufactured to a listed specification must also pass the weldability tests prescribed in paragraph II-B of Appendix B to this part.

(d) Steel pipe that has not been previously used may be used as replacement pipe in a segment of pipeline if it has been manufactured prior to November 12, 1970, in accordance with the same specification as the pipe used in constructing that segment of pipeline.

(e) New steel pipe that has been cold expanded must comply with the mandatory provisions of API Standard 5LX.

(Sec. 3, Natural Gas Pipeline Safety Act of 1968, 49 U.S.C. 1672; sec. 1.58(d), regulations of the Office of the Secretary of Transportation, 49 CFR 1.58(d); the redelegation of authority to the Director, Office of Pipeline Safety, set forth in Appendix A to Part 1 of the regulations of the Office of the Secretary of Transportation, 49 CFR Part 1)

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 191-1, 35 FR 17660, Nov. 17, 1970; Amdt. 192-12, 38 FR 4761, Feb. 22, 1973]

§ 192.57 Cast iron or ductile iron pipe.

(a) New cast iron or new ductile iron pipe is qualified for use under this part if it has been manufactured in accordance with a listed specification.

(b) Used cast iron or used ductile iron pipe is qualified for use under this part if inspection shows that the pipe is sound and allows the makeup of tight joints and—

(1) It has been removed from an existing pipeline that operated at the same or higher pressure; or

(2) It was manufactured in accordance with a listed specification.

§ 192.59 Plastic pipe.

(a) New plastic pipe is qualified for use under this part if—

(1) When the pipe is manufactured, it is manufactured in accordance with the latest listed edition of a listed specification, except that before March 21, 1975, it may be manufactured in accordance with any listed edition of a listed specification; and

(2) It is resistant to chemicals with which contact may be anticipated.

(b) Used plastic pipe is qualified for use under this part if—

(1) When the pipe was manufactured, it was manufactured in accordance with the latest listed edition of a listed specification, except that pipe manufactured before March 21, 1975, need only have met the requirements of any listed edition of a listed specification;

(2) It is resistant to chemicals with which contact may be anticipated;

(3) It has been used only in natural gas service;

(4) Its dimensions are still within the tolerances of the specification to which it was manufactured; and

(5) It is free of visible defects.

(c) For the purpose of paragraphs (a)(1) and (b)(1) of this section, where pipe of a diameter included in a listed specification is impractical to use, pipe of a diameter between the sizes included in a listed specification may be used if it—

(1) Meets the strength and design criteria required of pipe included in that listed specification; and

(2) Is manufactured from plastic compounds which meet the criteria for material required of pipe included in that listed specification.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-19, 40 FR 10472, Mar. 6, 1975]

§ 192.61 Copper pipe.

Copper pipe is qualified for use under this part if it has been manufactured in accordance with a listed specification.

§ 192.63 Marking of materials.

(a) Except as provided in paragraph (e) of this section, each valve, fitting, length of pipe, and other component must be marked as prescribed in—

(1) The specification or standard to which it was manufactured; or

(2) MSS Standard Practice, SP-25.

(b) In addition to the requirements in paragraph (a) of this section, thermoplastic pipe manufactured in accordance with the 1974a or earlier listed edition of ASTM D2513 must be marked as required by section 9.2 of ASTM D2513 (1975b edition) unless the pipe was manufactured before May 18, 1978, and is installed where operating temperatures are not above 38° C (100° F).

(c) Surfaces of pipe and components that are subject to stress from internal pressure may not be field die stamped.

(d) If any item is marked by die stamping, the die must have blunt or rounded edges that will minimize stress concentrations.

(e) Paragraph (a) of this section does not apply to items manufactured before November 12, 1970, that meet all of the following:

(1) The item is identifiable as to type, manufacturer, and model.

(2) Specifications or standards giving pressure, temperature, and other appropriate criteria for the use of items are readily available.

(49 U.S.C. 1672; 49 U.S.C. 1804; App. A of Part 1 and App. A of Part 102 of 49 CFR)

[Amdt. 192-1, 35 FR 17660, Nov. 17, 1970, as amended by Amdt. 192-31, 43 FR 13883, Apr. 3, 1978]

§ 192.65 Transportation of pipe.

In a pipeline to be operated at a hoop stress of 20 percent or more of SMYS, an operator may not use pipe having an outer diameter to wall thickness ratio of 70 to 1, or more, that is transported by railroad unless—

(a) The transportation is performed in accordance with the 1972 edition of API RP5L1, except that before February 25, 1975, the transportation may be performed in accordance with the 1967 edition of API RP5L1.

(b) In the case of pipe transported before November 12, 1970, the pipe is tested in accordance with Subpart J of this part to at least 1.25 times the maximum allowable operating pressure if it is to be installed in a class 1 location and to at least 1.5 times the maximum allowable operating pressure if it is to be installed in a class 2, 3, or 4 location. Notwithstanding any shorter time period permitted under Subpart J of this part, the test pressure must be maintained for at least 8 hours.

(Sec. 3, Natural Gas Pipeline Safety Act of 1968, 49 U.S.C. 1672; sec. 1.58(d), regulations of the Office of the Secretary of Transportation, 49 CFR 1.58(d); the redelegation of authority to the Director, Office of Pipeline Safety, set forth in Appendix A to Part 1 of the regulations of the Office of the Secretary of Transportation, 49 CFR Part 1)

[Amdt. 192-12, 38 FR 4761, Feb. 22, 1973, as amended by Amdt. 192-17, 40 FR 6346, Feb. 11, 1975]

Subpart C—Pipe Design

§ 192.101 Scope.

This subpart prescribes the minimum requirements for the design of pipe.

§ 192.103 General.

Pipe must be designed with sufficient wall thickness, or must be installed with adequate protection, to withstand anticipated external pressures and loads that will be imposed on the pipe after installation.

§ 192.105 Design formula for steel pipe.

(a) The design pressure for steel pipe is determined in accordance with the following formula:

$$P=(2\,St/D)\times F\times E\times T$$

P=Design pressure in pounds per square inch gauge.

S=Yield strength in pounds per square inch determined in accordance with § 192.107.

D=Nominal outside diameter of the pipe in inches.

t=Nominal wall thickness of the pipe in inches. If this is unknown, it is determined in accordance with § 192.109. Additional wall thickness required for concurrent external loads in accordance with § 192.103 may not be included in computing design pressure.

F=Design factor determined in accordance with § 192.111.

E=Longitudinal joint factor determined in accordance with § 192.113.

T=Temperature derating factor determined in accordance with § 192.115.

(b) If steel pipe that has been cold worked to meet the SMYS is heated, other than by welding, to 600° F. or more, the design pressure is limited to 75 percent of the pressure determined under paragraph (a) of this section.

§ 192.107 Yield strength (S) for steel pipe.

(a) For pipe that is manufactured in accordance with a specification listed in section I of Appendix B of this part, the yield strength to be used in the design formula in § 192.105 is the SMYS stated in the listed specification, if that value is known.

(b) For pipe that is manufactured in accordance with a specification not listed in section I of Appendix B to this part or whose specification or tensile properties are unknown, the yield strength to be used in the design formula in § 192.105 is one of the following:

(1) If the pipe is tensile tested in accordance with section 11-D of Appendix B to this part, the lower of the following:

(i) 80 percent of the average yield strength determined by the tensile tests.

(ii) The lowest yield strength determined by the tensile tests, but not more than 52,000 p.s.i.

(2) If the pipe is not tensile tested as provided in paragraph (b)(1) of this section 24,000 p.s.i.

§ 192.109 Nominal wall thickness (t) for steel pipe.

(a) If the nominal wall thickness for steel pipe is not known, it is determined by measuring the thickness of each piece of pipe at quarter points on one end.

(b) However, if the pipe is of uniform grade, size, and thickness and there are more than 10 lengths, only 10 percent of the individual lengths, but not less than 10 lengths, need be measured. The thickness of the lengths that are not measured must be verified by applying a gauge set to the minimum thickness found by the measurement. The nominal wall thickness to be used in the design formula in § 192.105 is the next wall thickness found in commercial specifications that is below the average of all the measurements taken. However, the nominal wall thickness used may not be more than 1.14 times the smallest measurement taken on pipe less than 20 inches in outside diameter, nor more than 1.11 times the smallest measurement taken on pipe 20 inches or more in outside diameter.

§ 192.111 Design factor (F) for steel pipe.

(a) Except as otherwise provided in paragraphs (b), (c), and (d) of this section, the design factor to be used in the design formula in § 192.105 is determined in accordance with the following table:

Class location	Design factor (*F*)
1	0.72
2	0.60
3	0.50
4	0.40

(b) A design factor of 0.60 or less must be used in the design formula in § 192.105 for steel pipe in Class 1 locations that:

(1) Crosses the right-of-way of an unimproved public road, without a casing;

(2) Crosses without a casing, or makes a parallel encroachment on, the right-of-way of either a hard surfaced road, a highway, a public street, or a railroad;

(3) Is supported by a vehicular, pedestrian, railroad, or pipeline bridge; or

(4) Is used in a fabricated assembly, (including separators, mainline valve assemblies, cross-connections, and river crossing headers) or is used within five pipe diameters in any direction from the last fitting of a fabricated assembly, other than a transition piece or an elbow used in place of a pipe bend which is not associated with a fabricated assembly.

(c) For Class 2 locations, a design factor of 0.50, or less, must be used in the design formula in § 192.105 for uncased steel pipe that crosses the right-of-way of a hard surfaced road, a highway, a public street, or a railroad.

(d) For Class 1 and Class 2 locations, a design factor of 0.50, or less, must be used in the design formula in § 192.105 for—

(1) Steel pipe in a compressor station, regulating station, or measuring station; and

(2) Steel pipe, including a pipe riser, on a platform located offshore or in inland navigable waters.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976]

§ 192.113 Longitudinal joint factor (*E*) for steel pipe.

The longitudinal joint factor to be used in the design formula in § 192.105 is determined in accordance with the following table:

Specification	Pipe class	Longitudinal joint factor (E)
ASTM A 53	Seamless	1.00
	Electric resistance welded	1.00
	Furnace butt welded	.60
ASTM A 106	Seamless	1.00
ASTM A 134	Electric fusion arc welded	.80
ASTM A 135	Electric resistance welded	1.00
ASTM A 139	Electric fusion arc welded	.80
ASTM A 211	Spiral welded steel pipe	.80
ASTM A 333	Seamless	1.00
	Electric resistance welded	1.00
ASTM A 381	Double submerged arc welded	1.00
ASTM A 671	Electric-fusion-welded	1.00
ASTM A 672	Electric-fusion-welded	1.00
ASTM A 691	Electric-fusion-welded	1.00
API 5 L	Seamless	1.00
	Electric resistance welded	1.00
	Electric flash welded	1.00
	Submerged arc welded	1.00
	Furnace butt welded	.60
API 5 LX	Seamless	1.00
	Electric resistance welded	1.00
	Electric flash welded	1.00
	Submerged arc welded	1.00
API 5 LS	Electric resistance welded	1.00
	Submerged arc welded	1.00
Other	Pipe over 4 inches	.80
Other	Pipe 4 inches or less	.60

If the type of longitudinal joint cannot be determined, the joint factor to be used must not exceed that designated for "Other."

[Amdt. 192-37, 46 FR 10159, Feb. 2, 1981]

§ 192.115 Temperature derating factor (*T*) for steel pipe.

The temperature derating factor to be used in the design formula in § 192.105 is determined as follows:

Gas temperature in degrees Fahrenheit	Temperature derating factor (T)
250 or less	1.000
300	0.967
350	0.933
400	0.900
450	0.867

For intermediate gas temperatures, the derating factor is determined by interpolation.

§ 192.117 Design of cast iron pipe.

Cast iron pipe must be designed in accordance with ANSI C101-67.

[Amdt. 192-37, 46 FR 10159, Feb. 2, 1981]

§ 192.119 Design of ductile iron pipe.

(a) Ductile iron pipe must be designed in accordance with ANSI A21.50 using the following values in the design equations:

s (design hoop stress) = 16,800 p.s.i.
f (design bending stress) = 36,000 p.s.i.

(b) Ductile iron pipe must be grade (60-42-10) and must conform to the requirements of ANSI A21.52.

§ 192.121 Design of plastic pipe.

The design pressure for plastic pipe is determined in accordance with the following formula, subject to the limitations of § 192.123:

$$P = 2S \frac{t}{(D-t)} \times 0.32$$

P = Design pressure, gage, kPa (psi).
S = For thermoplastic pipe the long-term hydrostatic strength determined in accordance with the listed specification at a temperature equal to 23° C (73° F), 38° C (100° F), 49° C (120° F), or 60° C (140° F); for reinforced thermosetting plastic pipe, 75,800 kPa (11,000 psi).
t = Specified wall thickness, mm (in.).
D = Specified outside diameter, mm (in.)

(49 U.S.C. 1672; 49 U.S.C. 1804, App. A. of part 1, 49 CFR)

[Amdt. 192-31, 43 FR 13883, Apr. 3, 1978; 43 FR 43308, Sept. 25, 1978]

§ 192.123 Design limitations for plastic pipe.

(a) The design pressure may not exceed a gauge pressure of 689 kPa (100 psig) for plastic pipe used in—

(1) Distribution systems; or

(2) Classes 3 and 4 locations.

(b) Plastic pipe may not be used where operating temperatures of the pipe will be—

(1) Below minus 29° C (−20° F); or

(2) In the case of thermoplastic pipe, above the temperature at which the long-term hydrostatic strength used in the design formula under § 192.121 is determined, except that pipe manufactured before May 18, 1978, may be used at temperatures up to 38° C (100° F); or in the case of reinforced thermosetting plastic pipe, above 66° C (150° F).

(c) The wall thickness for thermoplastic pipe may not be less than 1.57 millimeters (0.062 in.).

(d) The wall thickness for reinforced thermosetting plastic pipe may not be less than that listed in the following table:

Nominal size in inches	Minimum wall thickness in millimeters (inches)
2	1.52 (0.060)
3	1.52 (0.060)
4	1.78 (0.070)
6	2.54 (0.100)

(49 U.S.C. 1672; 49 U.S.C. 1804, App. A. of Part 1, 49 CFR)

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-31, 43 FR 13883, Apr. 3, 1978]

§ 192.125 Design of copper pipe.

(a) Copper pipe used in mains must have a minimum wall thickness of 0.065 inches and must be hard drawn.

(b) Copper pipe used in service lines must have a minimum wall thickness as specified for type "L" pipe in ASTM B 88.

(c) Copper pipe used in mains and service lines may not be used at pressures in excess of 100 p.s.i.g.

(d) Copper pipe that does not have an internal corrosion resistant lining may not be used to carry gas that has an average hydrogen sulfide content of more than 0.3 grains per 100 standard cubic feet of gas.

Subpart D—Design of Pipeline Components

§ 192.141 Scope.

This subpart prescribes minimum requirements for the design and installation of pipeline components and facilities. In addition, it prescribes requirements relating to protection against accidental overpressuring.

§ 192.143 General requirements.

Each component of a pipeline must be able to withstand operating pressures and other anticipated loadings with unit stresses equivalent to those allowed for comparable material in pipe in the same location and kind of service.

§ 192.145 Valves.

(a) Each valve must meet the minimum requirements, or the equivalent, of API 6A, API 6D, MSS SP-70, MSS SP-71, or MSS SP-78. A valve may not be used under operating conditions that exceed the applicable pressure-temperature ratings contained in those standards.

(b) Each valve must be able to meet the anticipated operating conditions.

(c) No valve having shell components made of ductile iron may be used at pressures exceeding 80 percent of the pressure ratings for comparable steel valves at their listed temperature. However, a valve having shell components made of ductile iron may be used at pressures up to 80 percent of the pressure ratings for comparable steel valves at their listed temperature, if—

(1) The temperature-adjusted service pressure does not exceed 1,000 p.s.i.g.; and

(2) Welding is not used on any ductile iron component in the fabrication of the valve shells or their assembly.

(d) No value having pressure containing parts made of ductile iron may be used in the gas pipe components of compressor stations.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10159, Feb. 2, 1981]

§ 192.147 Flanges and flange accessories.

(a) *General requirements.* Each flange or flange accessory must meet the minimum requirements of ANSI B16.5, MSS SP-44, or ANSI B16.24, or the equivalent.

(b) Each flange assembly must be able to withstand the maximum pressure at which the pipeline is to be operated and to maintain its physical and chemical properties at any temperature to which it is anticipated that it might be subjected in service.

§ 192.149 Standard fittings.

(a) The minimum metal thickness of threaded fittings may not be less than specified for the pressures and temperatures in the applicable standards referenced in this part, or their equivalent.

(b) Each steel butt-welding fitting must have pressure and temperature ratings based on stresses for pipe of the same or equivalent material. The actual bursting strength of the fitting must at least equal the computed bursting strength of pipe of the designated material and wall thickness, as determined by a prototype that was tested to at least the pressure required for the pipeline to which it is being added.

§ 192.151 Tapping.

(a) Each mechanical fitting used to make a hot tap must be designed for at least the operating pressure of the pipeline.

(b) Where a ductile iron pipe is tapped, the extent of full-thread engagement and the need for the use of outside-sealing service connections, tapping saddles, or other fixtures must be determined by service conditions.

(c) Where a threaded tap is made in cast iron or ductile iron pipe, the diameter of the tapped hole may not be more than 25 percent of the nominal diameter of the pipe unless the pipe is reinforced, except that

(1) Existing taps may be used for replacement service, if they are free of cracks and have good threads; and

(2) A 1¼-inch tap may be made in a 4-inch cast iron or ductile iron pipe, without reinforcement.

However, in areas where climate, soil, and service conditions may create unusual external stresses on cast iron pipe, unreinforced taps may be used only on 6-inch or larger pipe.

§ 192.153 Components fabricated by welding.

(a) Except for branch connections and assemblies of standard pipe and fittings joined by circumferential welds, the design pressure of each component fabricated by welding, whose strength cannot be determined, must be established in accordance with paragraph UG-101 of section VIII of the ASME Boiler and Pressure Vessel Code.

(b) Each prefabricated unit that uses plate and longitudinal seams must be designated, constructed, and tested in accordance with the ASME Boiler and Pressure Vessel Code, except for the following:

(1) Regularly manufactured butt-welding fittings.

(2) Pipe that has been produced and tested under a specification listed in Appendix B to this part.

(3) Partial assemblies such as split rings or collars.

(4) Prefabricated units that the manufacturer certifies have been tested to at least twice the maximum pressure to which they will be subjected under the anticipated operating conditions.

(c) Orange-peel bull plugs and orange-peel swages may not be used on pipelines that are to operate at a hoop stress of 20 percent or more of the SMYS of the pipe.

(d) Except for flat closures designed in accordance with section VIII of the ASME Boiler and Pressure Code, flat closures and fish tails may not be used on pipe that either operates at 100 p.s.i.g., or more, or is more than 3 inches nominal diameter.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-1, 35 FR 17660, Nov. 17, 1970]

§ 192.155 Welded branch connections.

Each welded branch connection made to pipe in the form of a single connection, or in a header or manifold as a series of connections, must be designed to ensure that the strength of the pipeline system is not reduced, taking into account the stresses in the remaining pipe wall due to the opening in the pipe or header, the shear stresses produced by the pressure acting on the area of the branch opening, and any external loadings due to thermal movement, weight, and vibration.

§ 192.157 Extruded outlets.

Each extruded outlet must be suitable for anticipated service conditions and must be at least equal to the design strength of the pipe and other fittings in the pipeline to which it is attached.

§ 192.159 Flexibility.

Each pipeline must be designed with enough flexibility to prevent thermal expansion or contraction from causing excessive stresses in the pipe or components, excessive bending or unusual loads at joints, or undesirable forces or moments at points of connection to equipment, or at anchorage or guide points.

§ 192.161 Supports and anchors.

(a) Each pipeline and its associated equipment must have enough anchors or supports to—

(1) Prevent undue strain on connected equipment;

(2) Resist longitudinal forces caused by a bend or offset in the pipe; and

(3) Prevent or damp out excessive vibration.

(b) Each exposed pipeline must have enough supports or anchors to protect the exposed pipe joints from the maximum end force caused by internal pressure and any additional forces caused by temperature expansion or contraction or by the weight of the pipe and its contents.

(c) Each support or anchor on an exposed pipeline must be made of durable, noncombustible material and must be designed and installed as follows:

(1) Free expansion and contraction of the pipeline between supports or anchors may not be restricted.

(2) Provision must be made for the service conditions involved.

(3) Movement of the pipeline may not cause disengagement of the support equipment.

(d) Each support on an exposed pipeline operated at a stress level of 50 percent or more of SMYS must comply with the following:

(1) A structural support may not be welded directly to the pipe.

(2) The support must be provided by a member that completely encircles the pipe.

(3) If an encircling member is welded to a pipe, the weld must be continuous and cover the entire circumference.

(e) Each underground pipeline that is connected to a relatively unyielding line or other fixed object must have enough flexibility to provide for possible movement, or it must have an anchor that will limit the movement of the pipeline.

(f) Except for offshore pipelines, each underground pipeline that is being connected to new branches must have a firm foundation for both the header and the branch to prevent lateral and vertical movement.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976]

§ 192.163 Compressor stations: Design and construction.

(a) *Location of compressor building.* Except for a compressor building on a platform located offshore or in inland navigable waters, each main compressor building of a compressor station must be located on property under the control of the operator. It must be far enough away from adjacent property, not under control of the operator, to minimize the possibility of fire being communicated to the compressor building from structures on adjacent property. There must be enough open space around the main compressor building to allow the free movement of fire-fighting equipment.

(b) *Building construction.* Each building on a compressor station site must be made of noncombustible materials if it contains either—

(1) Pipe more than 2 inches in diameter that is carrying gas under pressure; or

(2) Gas handling equipment other than gas utilization equipment used for domestic purposes.

(c) *Exits.* Each operating floor of a main compressor building must have at least two separated and unobstructed exits located so as to provide a convenient possibility of escape and an unobstructed passage to a place of safety. Each door latch on an exit must be of a type which can be readily opened from the inside without a key. Each swinging door located in an exterior wall must be mounted to swing outward.

(d) *Fenced areas.* Each fence around a compressor station must have at least two gates located so as to provide a convenient opportunity for escape to a place of safety, or have other facilities affording a similarly convenient exit from the area. Each gate located within 200 feet of any compressor plant building must open outward and, when occupied, must be openable from the inside without a key.

(e) *Electrical facilities.* Electrical equipment and wiring installed in compressor stations must conform to the National Electrical Code, NFPA-70 (ANSI), so far as that code is applicable.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976; Amdt. 192-37, 46 FR 10159, Feb. 2, 1981]

§ 192.165 Compressor stations: Liquid removal.

(a) Where entrained vapors in gas may liquefy under the anticipated pressure and temperature conditions, the compressor must be protected against the introduction of those liquids in quantities that could cause damage.

(b) Each liquid separator used to remove entrained liquids at a compressor station must—

(1) Have a manually operable means of removing these liquids.

(2) Where slugs of liquid could be carried into the compressors, have either automatic liquid removal facilities, an automatic compressor shutdown device, or a high liquid level alarm; and

(3) Be manufactured in accordance with section VIII of the ASME Boiler and Pressure Vessel Code, except that liquid separators constructed of pipe and fittings without internal welding must be fabricated with a design factor of 0.4, or less.

§ 192.167 Compressor stations: Emergency shutdown.

(a) Except for unattended field compressor stations of 1,000 horsepower or less, each compressor station must have an emergency shutdown system that meets the following:

(1) It must be able to block gas out of the station and blow down the station piping.

(2) It must discharge gas from the blowdown piping at a location where the gas will not create a hazard.

(3) It must provide means for the shutdown of gas compressing equipment, gas fires, and electrical facilities in the vicinity of gas headers and in the compressor building, except, that—

(i) Electrical circuits that supply emergency lighting required to assist station personnel in evacuating the compressor building and the area in the vicinity of the gas headers must remain energized; and

(ii) Electrical circuits needed to protect equipment from damage may remain energized.

(4) It must be operable from at least two locations, each of which is—

(i) Outside the gas area of the station;

(ii) Near the exit gates, if the station is fenced, or near emergency exits, if not fenced; and

(iii) Not more than 500 feet from the limits of the station.

(b) If a compressor station supplies gas directly to a distribution system with no other adequate source of gas available, the emergency shutdown system must be designed so that it will not function at the wrong time and cause an unintended outage on the distribution system.

(c) On a platform located offshore or in inland navigable waters, the emergency shutdown system must be designed and installed to actuate automatically by each of the following events:

(1) In the case of an unattended compressor station—

(i) When the gas pressure equals the maximum allowable operating pressure plus 15 percent; or

(ii) When an uncontrolled fire occurs on the platform; and

(2) In the case of a compressor station in a building—

(i) When an uncontrolled fire occurs in the building; or

(ii) When the concentration of gas in air reaches 50 percent or more of the lower explosive limit in a building which has a source of ignition.

For the purpose of paragraph (c)(2)(ii) of this section, an electrical facility which conforms to Class 1, Group D of the National Electrical Code is not a source of ignition.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34605, Aug. 16, 1976]

§ 192.169 Compressor stations: Pressure limiting devices.

(a) Each compressor station must have pressure relief or other suitable protective devices of sufficient capacity and sensitivity to ensure that the maximum allowable operating pressure of the station piping and equipment is not exceeded by more than 10 percent.

(b) Each vent line that exhausts gas from the pressure relief valves of a compressor station must extend to a location where the gas may be discharged without hazard.

§ 192.171 Compressor stations: Additional safety equipment.

(a) Each compressor station must have adequate fire protection facilities. If fire pumps are a part of these facilities, their operation may not be affected by the emergency shutdown system.

(b) Each compressor station prime mover, other than an electrical induction or synchronous motor, must have an automatic device to shut down the unit before the speed of either the prime mover or the driven unit exceeds a maximum safe speed.

(c) Each compressor unit in a compressor station must have a shutdown or alarm device that operates in the event of inadequate cooling or lubrication of the unit.

(d) Each compressor station gas engine that operates with pressure gas injection must be equipped so that stoppage of the engine automatically shuts off the fuel and vents the engine distribution manifold.

(e) Each muffler for a gas engine in a compressor station must have vent slots or holes in the baffles of each compartment to prevent gas from being trapped in the muffler.

§ 192.173 Compressor stations: Ventilation.

Each compressor station building must be ventilated to ensure that employees are not endangered by the accumulation of gas in rooms, sumps, attics, pits, or other enclosed places.

§ 192.175 Pipe-type and bottle-type holders.

(a) Each pipe-type and bottle-type holder must be designed so as to prevent the accumulation of liquids in the holder, in connecting pipe, or in auxiliary equipment, that might cause corrosion or interfere with the safe operation of the holder.

(b) Each pipe-type or bottle-type holder must have minimum clearance from other holders in accordance with the following formula:

$$C=(3D\times P\times F)/1{,}000$$

in which:

C=Minimum clearance between pipe containers or bottles in inches.
D=Outside diameter of pipe containers or bottles in inches.
P=Maximum allowable operating pressure, p.s.i.g.
F=Design factor as set forth in § 192.111 of this part.

§ 192.177 Additional provisions for bottle-type holders.

(a) Each bottle-type holder must be—

(1) Located on a storage site entirely surrounded by fencing that prevents access by unauthorized persons and with minimum clearance from the fence as follows:

Maximum allowable operating pressure	Minimum clearance (feet)
Less than 1,000 p.s.i.g	25
1,000 p.s.i.g. or more	100

(2) Designed using the design factors set forth in § 192.111; and

(3) Buried with a minimum cover in accordance with § 192.327.

(b) Each bottle-type holder manufactured from steel that is not weldable under field conditions must comply with the following:

(1) A bottle-type holder made from alloy steel must meet the chemical and tensile requirements for the various grades of steel in either API Standard 5A or ASTM A 372.

(2) The actual yield-tensile ratio of the steel may not exceed 0.85.

(3) Welding may not be performed on the holder after it has been heat treated or stress relieved, except that copper wires may be attached to the small diameter portion of the bottle end closure for cathodic protection if a localized thermit welding process is used.

(4) The holder must be given a mill hydrostatic test at a pressure that produces a hoop stress at least equal to 85 percent of the SMYS.

(5) The holder, connection pipe, and components must be leak tested after installation as required by Subpart J of this part.

§ 192.179 Transmission line valves.

(a) Each transmission line, other than offshore segments, must have sectionalizing block valves spaced as follows:

(1) Each point on the pipeline in a Class 4 location must be within 2½ miles of a valve.

(2) Each point on the pipeline in a Class 3 location must be within 4 miles of a valve.

(3) Each point on the pipeline in a Class 2 location must be within 7½ miles of a valve.

(4) Each point on the pipeline in a Class 1 location must be within 10 miles of a valve.

(b) Each sectionalizing block valve on a transmission line, other than offshore segments, must comply with the following:

(1) The valve and the operating device to open or close the valve must be readily accessible and protected from tampering and damage.

(2) The valve must be supported to prevent settling of the valve or movement of the pipe to which it is attached.

(c) Each section of a transmission line, other than offshore segments, between main line valves must have a blow-down valve with enough capacity to allow the transmission line to be blown down as rapidly as practicable. Each blowdown discharge must be located so the gas can be blown to the atmosphere without hazard and, if the transmission line is adjacent to an overhead electric line, so that the gas is directed away from the electrical conductors.

(d) Offshore segments of transmission lines must be equipped with valves or other components to shut off the flow of gas to an offshore platform in an emergency.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34606, Aug. 16, 1976]

§ 192.181 Distribution line valves.

(a) Each high-pressure distribution system must have valves spaced so as to reduce the time to shut down a section of main in an emergency. The valve spacing is determined by the operating pressure, the size of the mains, and the local physical conditions.

(b) Each regulator station controlling the flow or pressure of gas in a distribution system must have a valve installed on the inlet piping at a distance from the regulator station sufficient to permit the operation of the valve during an emergency that might preclude access to the station.

(c) Each valve on a main installed for operating or emergency purposes must comply with the following:

(1) The valve must be placed in a readily accessible location so as to facilitate its operation in an emergency.

(2) The operating stem or mechanism must be readily accessible.

(3) If the valve is installed in a buried box or enclosure, the box or enclosure must be installed so as to avoid transmitting external loads to the main.

§ 192.183 Vaults: Structural design requirements.

(a) Each underground vault or pit for valves, pressure relieving, pressure limiting, or pressure regulating stations, must be able to meet the loads which may be imposed upon it, and to protect installed equipment.

(b) There must be enough working space so that all of the equipment required in the vault or pit can be properly installed, operated, and maintained.

(c) Each pipe entering, or within, a regulator vault or pit must be steel for sizes 10 inches, and less, except that control and gage piping may be copper. Where pipe extends through the vault or pit structure, provision must be made to prevent the passage of gasses or liquids through the opening and to avert strains in the pipe.

§ 192.185 Vaults: Accessibility.

Each vault must be located in an accessible location and, so far as practical, away from—

(a) Street intersections or points where traffic is heavy or dense;

(b) Points of minimum elevation, catch basins, or places where the access cover will be in the course of surface waters; and

(c) Water, electric, steam, or other facilities.

§ 192.187 Vaults: Sealing, venting, and ventilation.

Each underground vault or closed top pit containing either a pressure regulating or reducing station, or a pressure limiting or relieving station, must be sealed, vented or ventilated, as follows:

(a) When the internal volume exceeds 200 cubic feet—

(1) The vault or pit must be ventilated with two ducts, each having at least the ventilating effect of a pipe 4 inches in diameter;

(2) The ventilation must be enough to minimize the formation of combustible atmosphere in the vault or pit; and

(3) The ducts must be high enough above grade to disperse any gas-air mixtures that might be discharged.

(b) When the internal volume is more than 75 cubic feet but less than 200 cubic feet—

(1) If the vault or pit is sealed, each opening must have a tight fitting cover without open holes through which an explosive mixture might be ignited, and there must be a means for testing the internal atmosphere before removing the cover;

(2) If the vault or pit is vented, there must be a means of preventing external sources of ignition from reaching the vault atmosphere; or

(3) If the vault or pit is ventilated, paragraph (a) or (c) of this section applies.

(c) If a vault or pit covered by paragraph (b) of this section is ventilated by openings in the covers or gratings and the ratio of the internal volume, in cubic feet, to the effective ventilating area of the cover or grating, in square feet, is less than 20 to 1, no additional ventilation is required.

§ 192.189 Vaults: Drainage and waterproofing.

(a) Each vault must be designed so as to minimize the entrance of water.

(b) A vault containing gas piping may not be connected by means of a drain connection to any other underground structure.

(c) All electrical equipment in vaults must conform to the applicable requirements of Class 1, Group D, of the National Electrical Code, ANSI Standard C1.

§ 192.191 Design pressure of plastic fittings.

(a) Thermosetting fittings for plastic pipe must conform to ASTM D 2517.

(b) The design pressure of acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) Schedule 40 and 80 thermoplastic fittings must be obtained from the following table:

DESIGN PRESSURE OF THERMOPLASTIC FITTINGS, P.S.I.G. OF VARIOUS STRENGTHS, MATERIALS AND CLASS LOCATIONS

Size inches	Schedule	ABS Type I and PVC Type II class location			PVC Type I class location		
		1	2 and 3	4	1	2 and 3	4
½	40	100	100	100	100	100	100
	80	100	100	100	100	100	100
¾	40	100	100	96	100	100	100
	80	100	100	100	100	100	100
1	40	100	100	90	100	100	100
	80	100	100	100	100	100	100
1¼	40	100	92	74	100	100	100
	80	100	100	100	100	100	100
1½	40	100	83	66	100	100	100
	80	100	100	94	100	100	100
2	40	89	69	55	100	100	100
	80	100	100	81	100	100	100
2½	40	99	76	61	100	100	100
	80	100	100	85	100	100	100
3	40	84	66	53	100	100	100
	80	100	94	75	100	100	100
3½	40	77	60	48	100	100	96
	80	100	86	69	100	100	100
4	40	71	56	44	100	100	89
	80	100	81	65	100	100	100
5	40	62	49	39	100	97	78
	80	93	72	58	100	100	100
6	40	56	44	35	100	88	71
	80	89	70	56	100	100	100

NOTE: These pressure ratings are the same value as the design pressure of the corresponding pipe size and schedule in the same class location, as determined by the formula given in § 192.121 and the limitations in § 192.123 of this part.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-1, 35 FR 17660, Nov. 17, 1970]

§ 192.193 Valve installation in plastic pipe.

Each valve installed in plastic pipe must be designed so as to protect the plastic material against excessive torsional or shearing loads when the valve or shutoff is operated, and from any other secondary stresses that might be exerted through the valve or its enclosure.

§ 192.195 Protection against accidental overpressuring.

(a) *General requirements.* Except as provided in § 192.197, each pipeline that is connected to a gas source so that the maximum allowable operating pressure could be exceeded as the result of pressure control failure or of some other type of failure, must have pressure relieving or pressure limiting devices that meet the requirements of §§ 192.199 and 192.201.

(b) *Additional requirements for distribution systems.* Each distribution system that is supplied from a source of gas that is at a higher pressure than the maximum allowable operating pressure for the system must—

(1) Have pressure regulation devices capable of meeting the pressure, load, and other service conditions that will be experienced in normal operation of the system, and that could be activated in the event of failure of some portion of the system; and

(2) Be designed so as to prevent accidental overpressuring.

§ 192.197 Control of the pressure of gas delivered from high-pressure distribution systems.

(a) If the maximum actual operating pressure of the distribution system is under 60 p.s.i.g. and a service regulator having the following characteristics is used, no other pressure limiting device is required:

(1) A regulator capable of reducing distribution line pressure to pressures recommended for household appliances.

(2) A single port valve with proper orifice for the maximum gas pressure at the regulator inlet.

(3) A valve seat made of resilient material designed to withstand abrasion of the gas, impurities in gas, cutting by the valve, and to resist permanent deformation when it is pressed against the valve port.

(4) Pipe connections to the regulator not exceeding 2 inches in diameter.

(5) A regulator that, under normal operating conditions, is able to regulate the downstream pressure within the necessary limits of accuracy and to limit the build-up of pressure under no-flow conditions to prevent a pressure that would cause the unsafe operation of any connected and properly adjusted gas utilization equipment.

(6) A self-contained service regulator with no external static or control lines.

(b) If the maximum actual operating pressure of the distribution system is 60 p.s.i.g., or less, and a service regulator that does not have all of the characteristics listed in paragraph (a) of this section is used, or if the gas contains materials that seriously interfere with the operation of service regulators, there must be suitable protective devices to prevent unsafe overpressuring of the customer's appliances if the service regulator fails.

(c) If the maximum actual operating pressure of the distribution system exceeds 60 p.s.i.g., one of the following methods must be used to regulate and limit, to the maximum safe value, the pressure of gas delivered to the customer:

(1) A service regulator having the characteristics listed in paragraph (a) of this section, and another regulator located upstream from the service regulator. The upstream regulator may not be set to maintain a pressure higher than 60 p.s.i.g. A device must be installed between the upstream regulator and the service regulator to limit the pressure on the inlet of the service regulator to 60 p.s.i.g. or less in case the upstream regulator fails to function properly. This device may be either a relief valve or an automatic shutoff that shuts, if the pressure on the inlet of the service regulator exceeds the set pressure (60 p.s.i.g. or less), and remains closed until manually reset.

(2) A service regulator and a monitoring regulator set to limit, to a maximum safe value, the pressure of the gas delivered to the customer.

(3) A service regulator with a relief valve vented to the outside atmosphere, with the relief valve set to open so that the pressure of gas going to the customer does not exceed a maximum safe value. The relief valve may either be built into the service regulator or it may be a separate unit installed downstream from the service regulator. This combination may be used alone only in those cases where the inlet pressure on the service regulator does not exceed the manufacturer's safe working pressure rating of the service regulator, and may not be used where the inlet pressure on the service regulator exceeds 125 p.s.i.g. For higher inlet pressures, the methods in paragraph (c) (1) or (2) of this section must be used.

(4) A service regulator and an automatic shutoff device that closes upon a rise in pressure downstream from the regulator and remains closed until manually reset.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-1, 35 FR 17660, Nov. 7, 1970]

§ 192.199 Requirements for design of pressure relief and limiting devices.

Except for rupture discs, each pressure relief or pressure limiting device must—

(a) Be constructed of materials such that the operation of the device will not be impaired by corrosion;

(b) Have valves and valve seats that are designed not to stick in a position that will make the device inoperative;

(c) Be designed and installed so that it can be readily operated to determine if the valve is free, can be tested to determine the pressure at which it will operate, and can be tested for leakage when in the closed position;

(d) Have support made of noncombustible material;

(e) Have discharge stacks, vents, or outlet ports designed to prevent accumulation of water, ice, or snow, located where gas can be discharged into the atmosphere without undue hazard;

(f) Be designed and installed so that the size of the openings, pipe, and fittings located between the system to be protected and the pressure relieving device, and the size of the vent line, are adequate to prevent hammering of the valve and to prevent impairment of relief capacity;

(g) Where installed at a district regulator station to protect a pipeline system from overpressuring, be designed and installed to prevent any single incident such as an explosion in a vault or damage by a vehicle from affecting the operation of both the overpressure protective device and the district regulator; and

(h) Except for a valve that will isolate the system under protection from its source of pressure, be designed to prevent unauthorized operation of any stop valve that will make the pressure relief valve or pressure limiting device inoperative.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-1, 35 FR 17660, Nov. 17, 1970]

§ 192.201 Required capacity of pressure relieving and limiting stations.

(a) Each pressure relief station or pressure limiting station or group of those stations installed to protect a pipeline must have enough capacity, and must be set to operate, to insure the following:

(1) In a low pressure distribution system, the pressure may not cause the unsafe operation of any connected and properly adjusted gas utilization equipment.

(2) In pipelines other than a low pressure distribution system—

(i) If the maximum allowable operating pressure is 60 p.s.i.g. or more, the pressure may not exceed the maximum allowable operating pressure plus 10 percent, or the pressure that produces a hoop stress of 75 percent of SMYS, whichever is lower;

(ii) If the maximum allowable operating pressure is 12 p.s.i.g. or more, but less than 60 p.s.i.g., the pressure may not exceed the maximum allowable operating pressure plus 6 p.s.i.g.; or

(iii) If the maximum allowable operating pressure is less than 12 p.s.i.g., the pressure may not exceed the maximum allowable operating pressure plus 50 percent.

(b) When more than one pressure regulating or compressor station feeds into a pipeline, relief valves or other protective devices must be installed at each station to ensure that the complete failure of the largest capacity regulator or compressor, or any single run of lesser capacity regulators or compressors in that station, will not impose pressures on any part of the pipeline or distribution system in excess of those for which it was designed, or against which it was protected, whichever is lower.

(c) Relief valves or other pressure limiting devices must be installed at or near each regulator station in a low-pressure distribution system, with a capacity to limit the maximum pressure in the main to a pressure that will not exceed the safe operating pressure for any connected and properly adjusted gas utilization equipment.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-9, 37 FR 20827, Oct. 4, 1972]

§ 192.203 Instrument, control, and sampling pipe and components.

(a) *Applicability.* This section applies to the design of instrument, control, and sampling pipe and components. It does not apply to permanently closed systems, such as fluid-filled temperature-responsive devices.

(b) *Materials and design.* All materials employed for pipe and components must be designed to meet the particular conditions of service and the following:

(1) Each takeoff connection and attaching boss, fitting, or adapter must be made of suitable material, be able to withstand the maximum service pressure and temperature of the pipe or equipment to which it is attached, and be designed to satisfactorily withstand all stresses without failure by fatigue.

(2) A shutoff valve must be installed in each takeoff line as near as practicable to the point of takeoff. Blowdown valves must be installed where necessary.

(3) Brass or copper material may not be used for metal temperatures greater than 400° F.

(4) Pipe or components that may contain liquids must be protected by heating or other means from damage due to freezing.

(5) Pipe or components in which liquids may accumulate must have drains or drips.

(6) Pipe or components subject to clogging from solids or deposits must have suitable connections for cleaning.

(7) The arrangement of pipe, components, and supports must provide safety under anticipated operating stresses.

(8) Each joint between sections of pipe, and between pipe and valves or fittings, must be made in a manner suitable for the anticipated pressure and temperature condition. Slip type expansion joints may not be used. Expansion must be allowed for by providing flexibility within the system itself.

(9) Each control line must be protected from anticipated causes of damage and must be designed and installed to prevent damage to any one control line from making both the regulator and the over-pressure protective device inoperative.

Subpart E—Welding of Steel in Pipelines

§ 192.221 Scope.

(a) This subpart prescribes minimum requirements for welding steel materials in pipelines.

(b) This subpart does not apply to welding that occurs during the manufacture of steel pipe or steel pipeline components.

§ 192.223 General.

(a) Welding must be performed in accordance with established written welding procedures that have been qualified under § 192.225 to produce sound, ductile welds.

(b) Welding must be performed by welders who are qualified under §§ 192.227 and 192.229 for the welding procedure to be used.

§ 192.225 Qualification of welding procedures.

(a) Each welding procedure must be qualified under section IX of the ASME Boiler and Pressure Vessel Code or section 2 of API Standard 1104, whichever is appropriate to the function of the weld, except that a welding procedure qualified under an earlier edition previously listed in Appendix A may continue to be used but may not be requalified under the earlier edition.

(b) When a welding procedure is being qualified under section IX of the ASME Boiler and Pressure Vessel Code, the following steels are considered to fall within the P-Number 1 grouping for the purpose of the essential variables and do not require separate qualification of welding procedures:

(1) Carbon steels that have a carbon content of 0.32 percent (heat analysis) or less.

(2) Carbon steels that have a carbon equivalent (C+¼ Mn) of 0.65 percent (heat analysis) or less.

(3) Alloy steels with weldability characteristics that have been shown to be similar to the carbon steels listed in paragraphs (b) (1) and (2) of this section.

Alloy steels and carbon steels that are not covered by paragraph (b) (1), (2), or (3) of this section require separate qualification of procedures for each individual pipe specification in accordance with sections VIII and IX of the ASME Boiler and Pressure Vessel Code.

(c) Each welding procedure must be recorded in detail during the qualifying tests. This record must be retained and followed whenever the procedure is used.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10159, Feb. 2, 1981]

§ 192.227 Qualification of welders.

(a) Except as provided in paragraph (c) of this section, each welder must be qualified in accordance with section IX of the ASME Boiler and Pressure Vessel Code or section 3 of API Standard 1104. However, a welder qualified under an earlier edition previously listed in Appendix A may weld but may not requalify under that earlier edition.

(b) When a welder is being qualified under section IX of the ASME Boiler and Pressure Vessel Code, the following steels are considered to fall within the P-Number 1 grouping for the purpose of the essential variables and do not require separate qualification:

(1) Carbon steels that have a carbon content of 0.32 percent (heat analysis) or less.

(2) Carbon steels that have a carbon equivalent (C+¼ Mn) of 0.65 percent (heat analysis) or less.

(3) Alloy steels with weldability characteristics that have been shown to be similar to the carbon steels listed in paragraphs (b) (1) and (2) of this section.

Alloy steels and carbon steels that are not covered by paragraph (b) (1), (2), or (3) of this section require separate qualification of welders for each individual pipe specification in accordance with sections VIII and IX of the ASME Boiler and Pressure Vessel Code.

(c) A welder may qualify to perform welding on pipe to be operated at a pressure that produces a hoop stress of less than 20 percent of SMYS by performing an acceptable test weld, for the process to be used, under the test set forth in section I of Appendix C to this part. A welder who makes welded service line connections to mains must also perform an acceptable test weld under section II of Appendix C to this part as a part of his qualifying test. After initial qualification, a welder may not perform welding unless—

(1) Within the preceding 12 calendar months, he has requalified; or

(2) Within the preceding 6 calendar months he has had—

(i) A production weld cut out, tested and found acceptable in accordance with the qualifying test; or

(ii) For welders who work only on service lines 2 inches or smaller in diameter, two sample welds tested and found acceptable in accordance with the test in section III of Appendix C to this part.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10159, Feb. 2, 1981]

§ 192.229 Limitations on welders.

(a) No welder whose qualification is based on nondestructive testing may weld compressor station pipe and components.

(b) No welder may weld with a particular welding process unless, within the preceding 6 calendar months, he has engaged in welding with that process.

(c) A welder qualified under § 192.227(a) may not weld unless within the preceding 6 calendar months the welder has had one weld tested and found acceptable under section 3 or 6 of API Standard 1104, except that a welder qualfied under an earlier edition previously listed in Appendix A may weld but may not requalify under that earlier edition.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10159, Feb. 2, 1981]

§ 192.231 Protection from weather.

The welding operation must be protected from weather conditions that would impair the quality of the completed weld.

§ 192.233 Miter joints.

(a) A miter joint on steel pipe to be operated at a pressure that produces a hoop stress of 30 percent or more of SMYS may not deflect the pipe more than 3°.

(b) A miter joint on steel pipe to be operated at a pressure that produces a hoop stress of less than 30 percent, but more than 10 percent, of SMYS may not deflect the pipe more than 12½° and must be a distance equal to one pipe diameter or more away from any other miter joint, as measured from the crotch of each joint.

(c) A miter joint on steel pipe to be operated at a pressure that produces a hoop stress of 10 percent or less of SMYS may not deflect the pipe more than 90°.

§ 192.235 Preparation for welding.

Before beginning any welding, the welding surfaces must be clean and free of any material that may be detrimental to the weld, and the pipe or component must be aligned to provide the most favorable condition for depositing the root bead. This alignment must be preserved while the root bead is being deposited.

§ 192.237 Preheating.

(a) Carbon steel that has a carbon content in excess of 0.32 percent (heat analysis) or a carbon equivalent (C+¼ Mn) of 0.65 percent (heat analysis) must be preheated for welding.

(b) Carbon steel that has a lower carbon content or carbon equivalent than the steels covered by paragraph (a) of this section must be preheated for welding when preheating will alleviate existing conditions that would limit the welding technique or tend to adversely affect the quality of the weld.

(c) When steel materials with different preheat temperatures are being preheated for welding, the higher temperature must be used.

(d) Preheat temperature must be monitored to ensure that the required preheat temperature is reached before, and maintained during, the welding operation.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10159, Feb. 2, 1981]

§ 192.239 Stress relieving.

(a) Except as provided in paragraph (f) of this section, each weld on carbon steel that has a carbon content in excess of 0.32 percent (heat analysis) or a carbon equivalent (C+¼ Mn) in excess of 0.65 percent (heat analysis) must be stress relieved as prescribed in section VIII of the ASME Boiler and Pressure Vessel Code.

(b) Except as provided in paragraph (f) of this section, each weld on carbon steel that has a carbon content of less than 0.32 percent (heat analysis) or a carbon equivalent (C+¼ Mn) of less than 0.65 percent (heat analyis) must be thermally stress relieved when conditions exist which cool the weld at a rate detrimental to the quality of the weld.

(c) Except as provided in paragraph (f) of this section, each weld on carbon steel pipe with a wall thickness of more than 1¼ inches must be stress relieved.

(d) When a weld connects pipe or components that are of different thickness, the wall thickness to be used in determining whether stress relieving is required under this section is—

(1) In the case of pipe connections, the thicker of the two pipes joined; or

(2) In the case of branch connections, slip-on flanges, or socket weld fittings, the thickness of the pipe run or header.

(e) Each weld of different materials must be stress relieved, if either material requires stress relieving under this section.

(f) Notwithstanding paragraphs (a), (b), and (c) of this section, stress relieving is not required for the following:

(1) A fillet or groove weld one-half inch, or less, in size (leg) that attaches a connection 2 inches, or less, in diameter; or

(2) A fillet or groove weld three-eighths inch, or less, in groove size that attaches a supporting member or other nonpressure attachment.

(g) Stress relieving required by this section must be performed at a temperature of at least 1,100° F. for carbon steels and at least 1,200° F. for ferritic alloy steels. When stress relieving a weld between steel materials with different stress relieving temperatures, the higher temperature must be used.

(h) When stress relieving, the temperature must be monitored to ensure that a uniform temperature is maintained and that the proper stress relieving cycle is accomplished.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10159, Feb. 2, 1981]

§ 192.241 Inspection and test of welds.

(a) Visual inspection of welding must be conducted to insure that—

(1) The welding is performed in accordance with the welding procedure; and

(2) The weld is acceptable under paragraph (c) of this section.

(b) The welds on a pipeline to be operated at a pressure that produces a hoop stress of 20 percent or more of SMYS must be nondestructively tested in accordance with § 192.243, except that welds that are visually inspected and approved by a qualified welding inspector need not be nondestructively tested if—

(1) The pipe has a nominal diameter of less than 6 inches; or

(2) The pipeline is to be operated at a pressure that produces a hoop stress of less than 40 percent of SMYS and the welds are so limited in number that nondestructive testing is impractical.

(c) The acceptability of a weld that is nondestructively tested or visually inspected is determined according to the standards in section 6 of API Standard 1104.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10160, Feb. 2, 1981]

§ 192.243 Nondestructive testing.

(a) Nondestructive testing of welds must be performed by any process, other than trepanning, that will clearly indicate defects that may affect the integrity of the weld.

(b) Nondestructive testing of welds must be performed—

(1) In accordance with written procedures; and

(2) By persons who have been trained and qualified in the established procedures and with the equipment employed in testing.

(c) Procedures must be established for the proper interpretation of each nondestructive test of a weld to ensure the acceptability of the weld under § 192.241(c).

(d) When nondestructive testing is required under § 192.241(b), the following percentages of each day's field butt welds, selected at random by the operator, must be nondestructively tested over their entire circumference:

(1) In Class 1 locations, except offshore, at least 10 percent.

(2) In Class 2 locations, at least 15 percent.

(3) In Class 3 and Class 4 locations, at crossings of major or navigable rivers, and offshore, 100 percent if practicable, but not less than 90 percent.

(4) Within railroad or public highway rights-of-way, including tunnels, bridges and overhead road crossings, and at pipeline tie-ins, 100 percent.

(e) Except for a welder whose work is isolated from the principal welding activity, a sample of each welder's work for each day must be nondestructively tested, when nondestructive testing is required under § 192.241(b).

(f) When nondestructive testing is required under § 192.241(b), each operator must retain, for the life of the pipeline, a record showing by milepost, engineering station, or by geographic feature, the number of girth welds made, the number nondestructively tested, the number rejected, and the disposition of the rejects.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34606, Aug. 16, 1976]

§ 192.245 Repair or removal of defects.

(a) Each weld that is unacceptable under § 192.241(c) must be removed or repaired. Except for welds on an offshore pipeline being installed from a pipelay vessel, a weld must be removed if it has a crack that is more than 2 inches long or that penetrates either the root or second bead.

(b) Each weld that is repaired must have the defect removed down to clean metal and the segment to be repaired must be preheated. After repair, the segment of the weld that was repaired must be inspected to ensure its acceptability. If the repair is not acceptable, the weld must be removed, except that additional repairs made in accordance with written welding procedures qualified under § 192.225 are permitted for welds on an offshore pipeline being installed from a pipelay vessel.

[Amdt. 192-27, 41 FR 34606, Aug. 16, 1976]

Subpart F—Joining of Materials Other Than by Welding

§ 192.271 Scope.

(a) This subpart prescribes minimum requirements for joining materials in pipelines, other than by welding.

(b) This subpart does not apply to joining during the manufacture of pipe or pipeline components.

§ 192.273 General.

(a) The pipeline must be designed and installed so that each joint will sustain the longitudinal pullout or thrust forces caused by contraction or expansion of the piping or by anticipated external or internal loading.

(b) Each joint must be made in accordance with written procedures that have been proven by test or experience to produce strong gastight joints.

(c) Each joint must be inspected to insure compliance with this subpart.

§ 192.275 Cast iron pipe.

(a) Each caulked bell and spigot joint in cast iron pipe must be sealed with mechanical leak clamps.

(b) Each mechanical joint in cast iron pipe must have a gasket made of a resilient material as the sealing medium. Each gasket must be suitably confined and retained under compression by a separate gland or follower ring.

(c) Cast iron pipe may not be joined by threaded joints.

(d) Cast iron pipe may not be joined by brazing.

(e) Each flange on a flanged joint in cast iron pipe must conform in dimensions and drilling to ANSI Standard B16.1 and be cast integrally with the pipe, valve, or fitting.

§ 192.277 Ductile iron pipe.

(a) Each mechanical joint in ductile iron pipe must conform to ANSI Standard A21.52 and ANSI Standard A21.11.

(b) Ductile iron pipe may not be joined by threaded joints.

(c) Ductile iron pipe may not be joined by brazing.

§ 192.279 Copper pipe.

Copper pipe may not be threaded, except that copper pipe used for joining screw fittings or valves may be threaded if the wall thickness is equivalent to the comparable size of standard wall pipe, as defined in ANSI Standard B36.10.

§ 192.281 Plastic pipe.

(a) *General.* A plastic pipe joint that is joined by solvent cement, adhesive, or heat fusion may not be disturbed until it has properly set. Plastic pipe may not be joined by a threaded joint or miter joint.

(b) *Solvent cement joints.* Each solvent cement joint on plastic pipe must comply with the following:

(1) The mating surfaces of the joint must be clean, dry, and free of material which might be deterimental to the joint.

(2) The solvent cement must conform to ASTM Specification D 2513.

(3) The safety requirements of Appendix A of ASTM Specification D 2513 must be met.

(4) The joint may not be heated to accelerate the setting of the cement.

(c) *Heat-fusion joints.* Each heat-fusion joint on plastic pipe must comply with the following:

(1) A butt heat-fusion joint must be joined by a device that holds the heater element square to the ends of the piping, compresses the heated ends together, and holds the pipe in proper alignment while the pastic hardens.

(2) A socket heat-fusion joint must be joined by a device that heats the mating surfaces of the joint uniformly and simultaneously to essentially the same temperature.

(3) Heat may not be applied with a torch or other open flame.

(d) *Adhesive joints.* Each adhesive joint on plastic pipe must comply with the following:

(1) The adhesive must conform to ASTM Specification D 2517.

(2) The materials and adhesive must be compatible with each other.

(e) *Mechanical joints.* Each compression type mechanical joint on plastic pipe must comply with the following:

(1) The gasket material in the coupling must be compatible with the plastic.

(2) A rigid internal tubular stiffener, other than a split tubular stiffner, must be used in conjection with the coupling.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR 1.53 and App. A to Part 1)

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-34, 44 FR 42973, July 23, 1979]

§ 192.283 Plastic pipe; qualifying joining procedures.

(a) *Heat Fusion, Solvent Cement, and Adhesive Joints.* Before any written procedure established under

§ 192.273(b) is used for making plastic pipe joints by a heat fusion, solvent cement, or adhesive method, the procedure must be qualified by subjecting specimen joints made according to the procedure to the following tests:

(1) The burst test requirements of—

(i) In the case of thermoplastic pipe, paragraph 8.6 (Sustained Pressure Test) or paragraph 8.7 (Minimum Hydrostatic Burst Pressure) of ASTM D2513; or

(ii) In the case of thermosetting plastic pipe, paragraph 8.5 (Minimum Hydrostatic Burst Pressure) or paragraph 8.9 (Sustained Static Pressure Test) of ASTM D2517;

(2) For procedures intended for lateral pipe connections, subject a specimen joint made from pipe sections joined at right angles according to the procedure to a force on the lateral pipe until failure occurs in the specimen. If failure initiates outside the joint area, the procedure qualifies for use; and

(3) For procedures intended for nonlateral pipe connections, follow the tensile test requirements of ASTM D638, except that the test may be conducted at ambient temperature and humidity. If the specimen elongates no less than 25 percent or failure initiates outside the joint area, the procedure qualifies for use.

(b) *Mechanical Joints.* Before any written procedure established under § 192.273(b) is used for making mechanical plastic pipe joints that are designed to withstand tensile forces, the procedure must be qualified by subjecting 5 specimen joints made according to the procedure to the following tensile test:

(1) Use an apparatus for the test as specified in ASTM D638-77a (except for conditioning).

(2) The specimen must be of such length that the distance between the grips of the apparatus and the end of the stiffener does not affect the joint strength.

(3) The speed of testing is 5.0 mm (0.20 in) per minute, plus or minus 25 percent.

(4) Pipe specimens less than 102 mm (4 in) in diameter are qualified if the pipe yields to an elongation of no less than 25 percent or failure initiates outside the joint area.

(5) Pipe specimens 102 mm (4 in) and larger in diameter shall be pulled until the pipe is subjected to a tensile stress equal to or greater than the maximum thermal stress that would be produced by a temperature change of 55.6° C (100° F) or until the pipe is pulled from the fitting. If the pipe pulls from the fitting, the lowest value of the five test results or the manufacturer's rating, whichever is lower must be used in the design calculations for stress.

(6) Each specimen that fails at the grips must be retested using new pipe.

(7) Results obtained pertain only to the specific outside diameter, and material of the pipe tested, except that testing of a heavier wall pipe may be used to qualify pipe of the same material but with a lesser wall thickness.

(c) A copy of each written procedure being used for joining plastic pipe must be available to the persons making and inspecting joints.

(d) Pipe or fittings manufactured before July 1, 1980, may be used in accordance with procedures that the manufacturer certifies will produce a joint as strong as the pipe.

(49 U.S.C. 1672, 1804, with regard to offshore gathering lines; 49 CFR 1.53 and Appendix A of Part 1)

[Amdt. 192-34A, 45 FR 9935, Feb. 14, 1980, as amended by Amdt. 192-34B, 46 FR 39, Jan. 2, 1981]

§ 192.285 Plastic pipe; qualifying persons to make joints.

(a) No person may make a plastic pipe joint unless that person has been qualified under the applicable joining procedure by—

(1) Appropriate training or experience in the use of the procedure; and

(2) Making a specimen joint from pipe sections joined according to the procedure that passes the inspection and test set forth in paragraph (b) of this section.

(b) The specimen joint must be—

(1) Visually examined during and after assembly or joining and found to have the same appearance as a joint or photographs of a joint that is acceptable under the procedure; and

(2) In the case of a heat fusion, solvent cement, or adhesive joint:

(i) Tested under any one of the test methods listed under § 192.283(a) applicable to the type of joint and material being tested;

(ii) Examined by ultrasonic inspection and found not to contain flaws that would cause failure; or

(iii) Cut into at least 3 longitudinal straps, each of which is—

(A) Visually examined and found not to contain voids or discontinuities on the cut surfaces of the joint area; and

(B) Deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area.

(c) A person must be requalified under an applicable procedure, if during any 12-month period that person—

(1) Does not make any joints under that procedure; or

(2) Has 3 joints or 3 percent of the joints made, whichever, is greater, under that procedure that are found unacceptable by testing under § 192.513.

(d) Each operator shall establish a method to determine that each person making joints in plastic pipelines in his system is qualified in accordance with this section.

(49 U.S.C. 1672; 49 U.S.C. 1804 with regard to offshore gathering lines; 49 CFR 1.53 and Appendix A of Part 1)

[Amdt. 192-34A, 45 FR 9935, Feb. 14, 1980, as amended by Amdt. 192-34B, 46 FR 39. Jan. 2, 1981]

§ 192.287 Plastic pipe; inspection of joints.

No person may carry out the inspection of joints in plastic pipes required by §§ 192.273(c) and 192.285(b) unless that person has been qualified by appropriate training or experience in evaluating the acceptability of plastic pipe joints made under the applicable joining procedure.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR 1.53 and App. A to Part 1)

[Amdt. 192-34, 44 FR 42974, July 23, 1979]

Subpart G—General Construction Requirements for Transmission Lines and Mains

§ 192.301 Scope.

This subpart prescribes minimum requirements for constructing transmission lines and mains.

§ 192.303 Compliance with specifications or standards.

Each transmission line or main must be constructed in accordance with comprehensive written specifications or standards that are consistent with this part.

§ 192.305 Inspection: General.

Each transmission line or main must be inspected to ensure that it is constructed in accordance with this part.

§ 192.307 Inspection of materials.

Each length of pipe and each other component must be visually inspected at the site of installation to ensure that it has not sustained any visually determinable damage that could impair its serviceability.

§ 192.309 Repair of steel pipe.

(a) Each imperfection or damage that impairs the serviceability of a length of steel pipe must be repaired or removed. If a repair is made by grinding, the remaining wall thickness must at least be equal to either:

(1) The minimum thickness required by the tolerances in the specification to which the pipe was manufactured; or

(2) The nominal wall thickness required for the design pressure of the pipeline.

(b) Each of the following dents must be removed from steel pipe to be operated at a pressure that produces a hoop stress of 20 percent, or more, of SMYS:

(1) A dent that contains a stress concentrator such as a scratch, gouge, groove, or arc burn.

(2) A dent that affects the longitudinal weld or a circumferential weld.

(3) In pipe to be operated at a pressure that produces a hoop stress of 40 percent or more of SMYS, a dent that has a depth of—

(i) More than one-quarter inch in pipe 12¾ inches or less in outer diameter; or

(ii) More than 2 percent of the nominal pipe diameter in pipe over 12¾ inches in outer diameter.

For the purpose of this section a "dent" is a depression that produces a gross disturbance in the curvature of the pipe wall without reducing the pipe-wall thickness. The depth of a dent is measured as the gap between the lowest point of the dent and a prolongation of the original contour of the pipe.

(c) Each arc burn on steel pipe to be operated at a pressure that produces a hoop stress of 40 percent, or more, of SMYS must be repaired or removed. If a repair is made by grinding, the arc burn must be completely removed and the remaining wall thickness must be at least equal to either:

(1) The minimum wall thickness required by the tolerances in the specification to which the pipe was manufactured; or

(2) The nominal wall thickness required for the design pressure of the pipeline.

(d) A gouge, groove, arc burn, or dent may not be repaired by insert patching or by pounding out.

(e) Each gouge, groove, arc burn, or dent that is removed from a length of pipe must be removed by cutting out the damaged portion as a cylinder.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-1, 35 FR 17660, Nov. 17, 1970]

§ 192.311 Repair of plastic pipe.

Each imperfection or damage that would impair the serviceability of plastic pipe must be repaired by a patching saddle or removed.

§ 192.313 Bends and elbows.

(a) Each field bend in steel pipe, other than a wrinkle bend made in accordance with § 192.315, must comply with the following:

(1) A bend must not impair the serviceability of the pipe.

(2) For pipe more than 4 inches in nominal diameter, the difference between the maximum and minimum diameter at a bend must not be more than 2½ percent of the nominal diameter.

(3) Each bend must have a smooth contour and be free from buckling, cracks, or any other mechanical damage.

(4) On pipe containing a longitudinal weld, the longitudinal weld must be as near as practicable to the neutral axis of the bend unless—

(i) The bend is made with an internal bending mandrel; or

(ii) The pipe is 12 inches or less in outside diameter or has a diameter to wall thickness ratio less than 70.

(b) Each circumferential weld of steel pipe which is located where the stress during bending causes a permanent deformation in the pipe must be nondestructively tested either before or after the bending process.

(c) Wrought-steel welding elbows and transverse segments of these elbows may not be used for changes in direction on steel pipe that is 2 inches or more in diameter unless the arc length, as measured along the crotch, is at least 1 inch.

[Amdt. No. 192-26, 41 FR 26018, June 24, 1976, as amended by Amdt. 192-29, 42 FR 42866, Aug. 25, 1977; Amdt. 192-29, 42 FR 60148, Nov. 25, 1977]

§ 192.315 Wrinkle bends in steel pipe.

(a) A wrinkle bend may not be made on steel pipe to be operated at a pressure that produces a hoop stress of 30 percent, or more, of SMYS.

(b) Each wrinkle bend on steel pipe must comply with the following:

(1) The bend must not have any sharp kinks.

(2) When measured along the crotch of the bend, the wrinkles must be a distance of at least one pipe diameter.

(3) On pipe 16 inches or larger in diameter, the bend may not have a deflection of more than 1½° for each wrinkle.

(4) On pipe containing a longitudinal weld the longitudinal seam must be as near as practicable to the neutral axis of the bend.

§ 192.317 Protection from hazards.

(a) Each transmission line or main must be protected from washouts, floods, unstable soil, landslides, or other hazards that may cause the pipeline to move or to sustain abnormal loads. In addition, offshore pipelines must be protected from damage by mud slides, water currents, hurricanes, ship anchors, and fishing operations.

(b) Each aboveground transmission line or main, not located offshore or in inland navigable water areas, must be protected from accidental damage by vehicular traffic or other similar causes, either by being placed at a safe distance from the traffic or by installing barricades.

(c) Pipelines, including pipe risers, on each platform located offshore or in inland navigable waters must be protected from accidental damage by vessels.

[Amdt. 192-27, 41 FR 34606, Aug. 16, 1976]

§ 192.319 Installation of pipe in a ditch.

(a) When installed in a ditch, each transmission line that is to be operated at a pressure producing a hoop stress of 20 percent or more of SMYS must be installed so that the pipe fits the ditch so as to minimize stresses and protect the pipe coating from damage.

(b) When a ditch for a transmission line or main is backfilled, it must be backfilled in a manner that—

(1) Provides firm support under the pipe; and

(2) Prevents damage to the pipe and pipe coating from equipment or from the backfill material.

(c) All offshore pipe in water at least 12 feet deep but not more than 200 feet deep, as measured from the mean low tide, must be installed so that the top of the pipe is below the natural bottom unless the pipe is supported by stanchions, held in place by anchors or heavy concrete coating, or protected by an equivalent means.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34606, Aug. 16, 1976]

§ 192.321 Installation of plastic pipe.

(a) Plastic pipe must be installed below ground level.

(b) Plastic pipe that is installed in a vault or any other below grade enclosure must be completely encased in gas-tight metal pipe and fittings that are adequately protected from corrosion.

(c) Plastic pipe must be installed so as to minimize shear or tensile stresses.

(d) Thermoplastic pipe that is not encased must have a minimum wall thickness of 0.090 inches, except that pipe with an outside diameter of 0.875 inches or less may have a minimum wall thickness of 0.062 inches.

(e) Plastic pipe that is not encased must have an electrically conductive wire or other means of locating the pipe while it is underground.

(f) Plastic pipe that is being encased must be inserted into the casing pipe in a manner that will protect the plastic. The leading end of the plastic must be closed before insertion.

§ 192.323 Casing.

Each casing used on a transmission line or main under a railroad or highway must comply with the following:

(a) The casing must be designed to withstand the superimposed loads.

(b) If there is a possibility of water entering the casing, the ends must be sealed.

(c) If the ends of an unvented casing are sealed and the sealing is strong enough to retain the maximum allowable operating pressure of the pipe, the casing must be designed to hold this pressure at a stress level of not more than 72 percent of SMYS.

(d) If vents are installed on a casing, the vents must be protected from the weather to prevent water from entering the casing.

§ 192.325 Underground clearance.

(a) Each transmission line must be installed with at least 12 inches of clearance from any other underground structure not associated with the transmission line. If this clearance cannot be attained, the transmission line must be protected from damage that might result from the proximity of the other structure.

(b) Each main must be installed with enough clearance from any other underground structure to allow proper maintenance and to protect against damage that might result from proximity to other structures.

(c) In addition to meeting the requirements of paragraph (a) or (b) of this section, each plastic transmission line or main must be installed with sufficient clearance, or must be insulated, from any source of heat so as to prevent the heat from impairing the serviceability of the pipe.

(d) Each pipe-type or bottle-type holder must be installed with a minimum clearance from any other holder as prescribed in § 192.175(b).

§ 192.327 Cover.

(a) Except as provided in paragraphs (c) and (e) of this section, each buried transmission line must be installed with a minimum cover as follows:

Location	Normal soil	Consolidated rock
	Inches	
Class 1 locations	30	18
Class 2, 3, and 4 locations	36	24
Drainage ditches of public roads and railroad crossings	36	24

(b) Except as provided in paragraphs (c) and (d) of this section, each buried main must be installed with at least 24 inches of cover.

(c) Where an underground structure prevents the installation of a transmission line or main with the minimum cover, the transmission line or main may be installed with less cover if it is provided with additional protection to withstand anticipated external loads.

(d) A main may be installed with less than 24 inches of cover if the law of the State or municipality—

(1) Establishes a minimum cover of less than 24 inches;

(2) Requires that mains be installed in a common trench with other utility lines; and

(3) Provides adequately for prevention of damage to the pipe by external forces.

(e) All pipe which is installed in a navigable river, stream, or harbor must have a minimum cover of 48 inches in soil or 24 inches in consolidated rock, and all pipe installed in any offshore location under water less than 12 feet deep, as measured from mean low tide, must have a minimum cover of 36 inches in soil or 18 inches in consolidated rock, between the top of the pipe and the natural bottom. However, less than the minimum cover is permitted in accordance with paragraph (c) of this section.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34606, Aug. 16, 1976]

Subpart H—Customer Meters, Service Regulators, and Service Lines

§ 192.351 Scope.

This subpart prescribes minimum requirements for installing customer meters, service regulators, service lines, service line valves, and service line connections to mains.

§ 192.353 Customer meters and regulators: Location.

(a) Each meter and service regulator, whether inside or outside of a building, must be installed in a readily accessible location and be protected from corrosion and other damage. However, the upstream regulator in a series may be buried.

(b) Each service regulator installed within a building must be located as near as practical to the point of service line entrance.

(c) Each meter installed within a building must be located in a ventilated place and not less than 3 feet from any source of ignition or any source of heat which might damage the meter.

(d) Where feasible, the upstream regulator in a series must be located outside the building, unless it is located in a separate metering or regulating building.

§ 192.355 Customer meters and regulators: Protection from damage.

(a) *Protection from vacuum or back pressure.* If the customer's equipment might create either a vacuum or a back pressure, a device must be installed to protect the system.

(b) *Service regulator vents and relief vents.* The outside terminal of each service regulator vent and relief vent must—

(1) Be rain and insect resistant;

(2) Be located at a place where gas from the vent can escape freely into

the atmosphere and away from any opening into the building; and

(3) Be protected from damage caused by submergence in areas where flooding may occur.

(c) *Pits and vaults.* Each pit or vault that houses a customer meter or regulator at a place where vehicular traffic is anticipated, must be able to support that traffic.

§ 192.357 Customer meters and regulators: Installation.

(a) Each meter and each regulator must be installed so as to minimize anticipated stresses upon the connecting piping and the meter.

(b) When close all-thread nipples are used, the wall thickness remaining after the threads are cut must meet the minimum wall thickness requirements of this part.

(c) Connections made of lead or other easily damaged material may not be used in the installation of meters or regulators.

(d) Each regulator that might release gas in its operation must be vented to the outside atmosphere.

§ 192.359 Customer meter installations: Operating pressure.

(a) A meter may not be used at a pressure that is more than 67 percent of the manufacturer's shell test pressure.

(b) Each newly installed meter manufactured after November 12, 1970, must have been tested to a minimum of 10 p.s.i.g.

(c) A rebuilt or repaired tinned steel case meter may not be used at a pressure that is more than 50 percent of the pressure used to test the meter after rebuilding or repairing.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-1, 35 FR 17660, Nov. 17, 1970]

§ 192.361 Service lines: Installation.

(a) *Depth.* Each buried service line must be installed with at least 12 inches of cover in private property and at least 18 inches of cover in streets and roads. However, where an underground structure prevents installation at those depths, the service line must be able to withstand any anticipated external load.

(b) *Support and backfill.* Each service line must be properly supported on undisturbed or well-compacted soil, and material used for backfill must be free of materials that could damage the pipe or its coating.

(c) *Grading for drainage.* Where condensate in the gas might cause interruption in the gas supply to the customer, the service line must be graded so as to drain into the main or into drips at the low points in the service line.

(d) *Protection against piping strain and external loading.* Each service line must be installed so as to minimize anticipated piping strain and external loading.

(e) *Installation of service lines into buildings.* Each underground service line installed below grade through the outer foundation wall of a building must—

(1) In the case of a metal service line, be protected against corrosion;

(2) In the case of a plastic service line, be protected from shearing action and backfill settlement; and

(3) Be sealed at the foundation wall to prevent leakage into the building.

(f) *Installation of service lines under buildings.* Where an underground service line is installed under a building—

(1) It must be encased in a gas-tight conduit;

(2) The conduit and the service line must, if the service line supplies the building it underlies, extend into a normally usable and accessible part of the building; and

(3) The space between the conduit and the service line must be sealed to prevent gas leakage into the building and, if the conduit is sealed at both ends, a vent line from the annular space must extend to a point where gas would not be a hazard, and extend above grade, terminating in a rain and insect resistant fitting.

§ 192.363 Service lines: Valve requirements.

(a) Each service line must have a service-line valve that meets the applicable requirements of Subparts B and D of this part. A valve incorporated in a meter bar, that allows the meter to be bypassed, may not be used as a service-line valve.

(b) A soft seat service line valve may not be used if its ability to control the flow of gas could be adversely affected by exposure to anticipated heat.

(c) Each service-line valve on a high-pressure service line, installed above ground or in an area where the blowing of gas would be hazardous, must be designed and constructed to minimize the possibility of the removal of the core of the valve with other than specialized tools.

§ 192.365 Service lines: Location of valves.

(a) *Relation to regulator or meter.* Each service-line valve must be installed upstream of the regulator or, if there is no regulator, upstream of the meter.

(b) *Outside valves.* Each service line must have a shut-off valve in a readily accessible location that, if feasible, is outside of the building.

(c) *Underground valves.* Each underground service-line valve must be located in a covered durable curb box or standpipe that allows ready operation of the valve and is supported independently of the service lines.

§ 192.367 Service lines: General requirements for connections to main piping.

(a) *Location.* Each service-line connection to a main must be located at the top of the main or, if that is not practical, at the side of the main, unless a suitable protective device is installed to minimize the possibility of dust and moisture being carried from the main into the service line.

(b) *Compression-type connection to main.* Each compression-type service line to main connection must—

(1) Be designed and installed to effectively sustain the longitudinal pull-out or thrust forces caused by contraction or expansion of the piping, or by anticipated external or internal loading; and

(2) If gaskets are used in connecting the service line to the main connection fitting, have gaskets that are compatible with the kind of gas in the system.

§ 192.369 Service lines: Connections to cast iron or ductile iron mains.

(a) Each service line connected to a cast iron or ductile iron main must be connected by a mechanical clamp, by drilling and tapping the main, or by another method meeting the requirements of § 192.273.

(b) If a threaded tap is being inserted, the requirements of § 192.151 (b) and (c) must also be met.

§ 192.371 Service lines: Steel.

Each steel service line to be operated at less than 100 p.s.i.g. must be constructed of pipe designed for a minimum of 100 p.s.i.g.

[Amdt. 192-1, 35 FR 17660, Nov. 17, 1970]

§ 192.373 Service lines: Cast iron and ductile iron.

(a) Cast or ductile iron pipe less than 6 inches in diameter may not be installed for service lines.

(b) If cast iron pipe or ductile iron pipe is installed for use as a service line, the part of the service line which extends through the building wall must be of steel pipe.

(c) A cast iron or ductile iron service line may not be installed in unstable soil or under a building.

§ 192.375 Service lines: Plastic.

(a) Each plastic service line outside a building must be installed below ground level, except that it may terminate above ground and outside the building, if—

(1) The above ground part of the plastic service line is protected against deterioration and external damage; and

(2) The plastic service line is not used to support external loads.

(b) Each plastic service line inside a building must be protected against external damage.

§ 192.377 Service lines: Copper.

Each copper service line installed within a building must be protected against external damage.

[Amdt. 192-8, 37 FR 20694, Oct. 3, 1972]

§ 192.379 New service lines not in use.

Each service line that is not placed in service upon completion of installation must comply with one of the following until the customer is supplied with gas:

(a) The valve that is closed to prevent the flow of gas to the customer must be provided with a locking device or other means designed to prevent the opening of the valve by persons other than those authorized by the operator.

(b) A mechanical device or fitting that will prevent the flow of gas must be installed in the service line or in the meter assembly.

(c) The customer's piping must be physically disconnected from the gas supply and the open pipe ends sealed.

Subpart I—Requirements for Corrosion Control

AUTHORITY: Natural Gas Pipeline Act of 1968 (49 U.S.C. sec. 1671 et seq.), Part I regulations of Office of the Secretary of Transportation, 49 CFR Part I, and delegation of authority to Director, Office of Pipeline Safety, 33 FR 16468, unless otherwise noted.

SOURCE: Amdt. 192-4, 36 FR 12302, June 30, 1971, unless otherwise noted.

§ 192.451 Scope.

(a) This subpart prescribes minimum requirements for the protection of metallic pipelines from external, internal, and atmospheric corrosion.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR App. A of Part 1)

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192-27, 41 FR 34606, Aug. 16, 1976; Amdt. 192-33, 43 FR 39389, Sept. 5, 1978]

§ 192.452 Applicability to converted pipelines.

Notwithstanding the date the pipeline was installed or any earlier deadlines for compliance, each pipeline which qualifies for use under this part in accordance with § 192.14 must meet the requirements of this subpart specifically applicable to pipelines installed before August 1, 1971, and all other applicable requirements within 1 year after the pipeline is readied for service. However, the requirements of this subpart specifically applicable to pipelines installed after July 31, 1971, apply if the pipeline substantially meets those requirements before it is readied for service or it is a segment which is replaced, relocated, or substantially altered.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR 1.53(a))

[Amdt. 192-30, 42 FR 60148, Nov. 25, 1977]

§ 192.453 General.

Each operator shall establish procedures to implement the requirements of this subpart. These procedures, including those for the design, installation, operation and maintenance of cathodic protection systems, must be carried out by, or under the direction of, a person qualified by experience and training in pipeline corrosion control methods.

§ 192.455 External corrosion control: Buried or submerged pipelines installed after July 31, 1971.

(a) Except as provided in paragraphs (b), (c), and (f) of this section, each buried or submerged pipeline installed after July 31, 1971, must be protected against external corrosion, including the following:

(1) It must have an external protective coating meeting the requirements of § 192.461.

(2) It must have a cathodic protection system designed to protect the pipeline in its entirety in accordance with this subpart, installed and placed in operation within one year after completion of construction.

(b) An operator need not comply with paragraph (a) of this section, if the operator can demonstrate by tests, investigation, or experience in the area of application, including, as a minimum, soil resistivity measurements and tests for corrosion accelerating bacteria, that a corrosive environment does not exist. However, within 6 months after an installation made pursuant to the preceding sentence, the operator shall conduct tests, including pipe-to-soil potential measurements with respect to either a continuous reference electrode or an electrode using close spacing, not to exceed 20 feet, and soil resistivity measurements at potential profile peak locations, to adequately evaluate the potential profile along the entire pipeline. If the tests made indicate that a corrosive condition exists, the pipeline must be cathodically protected in accordance with paragraph (a)(2) of this section.

(c) An operator need not comply with paragraph (a) of this section, if the operator can demonstrate by tests, investigation, or experience that—

(1) For a copper pipeline, a corrosive environment does not exist; or

(2) For a temporary pipeline with an operating period of service not to exceed 5 years beyond installation, corrosion during the 5-year period of service of the pipeline will not be detrimental to public safety.

(d) Notwithstanding the provisions of paragraph (b) or (c) of this section, if a pipeline is externally coated, it must be cathodically protected in accordance with paragraph (a)(2) of this section.

(e) Aluminum may not be installed in a buried or submerged pipeline if that aluminum is exposed to an environment with a natural pH in excess of 8, unless tests or experience indicate its suitability in the particular environment involved.

(f) This section does not apply to electrically isolated, metal alloy fittings in plastic pipelines if—

(1) For the size fitting to be used, an operator can show by tests, investigation, or experience in the area of application that adequate corrosion control is provided by alloyage;

(2) The fitting is designed to prevent leakage caused by localized corrosion pitting; and

(3) A means is provided for identifying the location of the fitting.

(49 U.S.C. 1672; 49 CFR 1.53(a))

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended at Amdt. 192-28, 42 FR 35654, July 11, 1977]

§ 192.457 External corrosion control: Buried or submerged pipelines installed before August 1, 1971.

(a) Except for buried piping at compressor, regulator, and measuring stations, each buried or submerged transmission line installed before August 1, 1971, that has an effective external coating must be cathodically protected along the entire area that is effectively coated, in accordance with this subpart. For the purposes of this subpart, a pipeline does not have an effective external coating if its cathodic protection current requirements are substantially the same as if it were bare. The operator shall make tests to determine the cathodic protection current requirements.

(b) Except for cast iron or ductile iron, each of the following buried or submerged pipelines installed before August 1, 1971, must be cathodically protected in accordance with this subpart in areas in which active corrosion is found:

(1) Bare or ineffectively coated transmission lines.

(2) Bare or coated pipes at compressor, regulator, and measuring stations.

(3) Bare or coated distribution lines. The operator shall determine the areas of active corrosion by electrical survey, or where electrical survey is impractical, by the study of corrosion and leak history records, by leak detection survey, or by other means.

(c) For the purpose of this subpart, active corrosion means continuing corrosion which, unless controlled, could result in a condition that is detrimental to public safety.

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39390, Sept. 5, 1978]

§ 192.459 External corrosion control: Examination of buried pipeline when exposed.

Whenever an operator has knowledge that any portion of a buried pipeline is exposed, the exposed portion must be examined for evidence of external corrosion if the pipe is bare, or if the coating is deteriorated. If external corrosion is found, remedial action must be taken to the extent required by § 192.483 and the applicable paragraphs of §§ 192.485, 192.487, or 192.489.

§ 192.461 External corrosion control: Protective coating.

(a) Each external protective coating, whether conductive or insulating, applied for the purpose of external corrosion control must—

(1) Be applied on a properly prepared surface;

(2) Have sufficient adhesion to the metal surface to effectively resist underfilm migration of moisture;

(3) Be sufficiently ductile to resist cracking;

(4) Have sufficient strength to resist damage due to handling and soil stress; and

(5) Have properties compatible with any supplemental cathodic protection.

(b) Each external protective coating which is an electrically insulating type must also have low moisture absorption and high electrical resistance.

(c) Each external protective coating must be inspected just prior to lowering the pipe into the ditch and backfilling, and any damage detrimental to effective corrosion control must be repaired.

(d) Each external protective coating must be protected from damage resulting from adverse ditch conditions or damage from supporting blocks.

(e) If coated pipe is installed by boring, driving, or other similar method, precautions must be taken to minimize damage to the coating during installation.

§ 192.463 External corrosion control: Cathodic protection.

(a) Each cathodic protection system required by this subpart must provide a level of cathodic protection that complies with one or more of the applicable criteria contained in Appendix D of this part. If none of these criteria is applicable, the cathodic protection system must provide a level of cathodic protection at least equal to that provided by compliance with one or more of these criteria.

(b) If amphoteric metals are included in a buried or submerged pipeline containing a metal of different anodic potential—

(1) The amphoteric metals must be electrically isolated from the remainder of the pipeline and cathodically protected; or

(2) The entire buried or submerged pipeline must be cathodically protected at a cathodic potential that meets the requirements of Appendix D of this part for amphoteric metals.

(c) The amount of cathodic protection must be controlled so as not to damage the protective coating or the pipe.

§ 192.465 External corrosion control: Monitoring.

(a) Each pipeline that is under cathodic protection must be tested at least once each calendar year, but with intervals not exceeding 15 months, to determine whether the cathodic protection meets the requirements of § 192.463. However, if tests at those intervals are impractical for separately protected short sections of mains or transmission lines, not in excess of 100 feet, or separately protected service lines, these pipelines may be surveyed on a sampling basis. At least 10 percent of these protected structures, distributed over the entire system must be surveyed each calendar year, with a different 10 percent checked each subsequent year, so that the entire system is tested in each 10-year period.

(b) Each cathodic protection rectifier or other impressed current power source must be inspected six times each calendar year, but with intervals not exceeding 2½ months, to insure that it is operating.

(c) Each reverse current switch, each diode, and each interference bond whose failure would jeopardize structure protection must be electrically checked for proper performance six times each calendar year, but with intervals not exceeding 2½ months. Each other interference bond must be checked at least once each calendar year, but with intervals not exceeding 15 months.

(d) Each operator shall take prompt remedial action to correct any deficiencies indicated by the monitoring.

(e) After the initial evaluation required by paragraphs (b) and (c) of § 192.455 and paragraph (b) of § 192.457, each operator shall, at intervals not exceeding 3 years, reevaluate its unprotected pipelines and cathodically protect them in accordance with this subpart in areas in which active corrosion is found. The operator shall determine the areas of active corrosion by electrical survey, or where electrical survey is impractical, by the study of corrosion and leak history records, by leak detection survey, or by other means.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR App. A of Part 1)

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39390, Sept. 5, 1978; Amdt. 192-35A, 45 FR 23441, Apr. 7, 1980]

§ 192.467 External corrosion control: Electrical isolation.

(a) Each buried or submerged pipeline must be electrically isolated from other underground metallic structures, unless the pipeline and the other structures are electrically interconnected and cathodically protected as a single unit.

(b) One or more insulating devices must be installed where electrical isolation of a portion of a pipeline is necessary to facilitate the application of corrosion control.

(c) Except for unprotected copper inserted in ferrous pipe, each pipeline must be electrically isolated from metallic casings that are a part of the underground system. However, if isolation is not achieved because it is impractical, other measures must be taken to minimize corrosion of the pipeline inside the casing.

(d) Inspection and electrical tests must be made to assure that electrical isolation is adequate.

(e) An insulating device may not be installed in an area where a combustible atmosphere is anticipated unless precautions are taken to prevent arcing.

(f) Where a pipeline is located in close proximity to electrical transmission tower footings, ground cables or counterpoise, or in other areas where fault currents or unusual risk of lightning may be anticipated, it must be provided with protection against damage due to fault currents or lightning, and protective measures must also be taken at insulating devices.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR App. A of Part 1)

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39390, Sept. 5, 1978]

§ 192.469 External corrosion control: Test stations.

Each pipeline under cathodic protection required by this subpart must have sufficient test stations or other contact points for electrical measurement to determine the adequacy of cathodic protection.

[Amdt. 192-27, 41 FR 34606, Aug. 16, 1976]

§ 192.471 External corrosion control: Test leads.

(a) Each test lead wire must be connected to the pipeline so as to remain mechanically secure and electrically conductive.

(b) Each test lead wire must be attached to the pipeline so as to minimize stress concentration on the pipe.

(c) Each bared test lead wire and bared metallic area at point of connection to the pipeline must be coated with an electrical insulating material compatible with the pipe coating and the insulation on the wire.

§ 192.473 External corrosion control: Interference currents.

(a) Each operator whose pipeline system is subjected to stray currents shall have in effect a continuing program to minimize the detrimental effects of such currents.

(b) Each impressed current type cathodic protection system or galvanic anode system must be designed and installed so as to minimize any adverse effects on existing adjacent underground metallic structures.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR App. A of Part 1)

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39390, Sept. 5, 1978]

§ 192.475 Internal corrosion control: General.

(a) Corrosive gas may not be transported by pipeline, unless the corrosive effect of the gas on the pipeline has been investigated and steps have been taken to minimize internal corrosion.

(b) Whenever any pipe is removed from a pipeline for any reason, the internal surface must be inspected for evidence of corrosion. If internal corrosion is found—

(1) The adjacent pipe must be investigated to determine the extent of internal corrosion;

(2) Replacement must be made to the extent required by the applicable paragraphs of §§ 192.485, 192.487, or 192.489; and

(3) Steps must be taken to minimize the internal corrosion.

(c) Gas containing more than 0.1 grain of hydrogen sulfide per 100 standard cubic feet may not be stored in pipe-type or bottle-type holders.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR App. A of Part 1)

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39390, Sept. 5, 1978]

§ 192.477 Internal corrosion control: Monitoring.

If corrosive gas is being transported, coupons or other suitable means must be used to determine the effectiveness of the steps taken to minimize internal corrosion. Each coupon or other means of monitoring internal corrosion must be checked two times each calendar year, but with intervals not exceeding 7½ months.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR App. A of Part 1)

[Amdt. 192-33, 43 FR 39390, Sept. 5, 1978]

§ 192.479 Atmospheric corrosion control: General.

(a) *Pipelines installed after July 31, 1971.* Each aboveground pipeline or portion of a pipeline installed after July 31, 1971 that is exposed to the atmosphere must be cleaned and either coated or jacketed with a material suitable for the prevention of atmospheric corrosion. An operator need not comply with this paragraph, if the operator can demonstrate by test, investigation, or experience in the area of application, that a corrosive atmosphere does not exist.

(b) *Pipelines installed before August 1, 1971.* Each operator having an above-ground pipeline or portion of a pipeline installed before August 1, 1971 that is exposed to the atmosphere, shall—

(1) Determine the areas of atmospheric corrosion on the pipeline;

(2) If atmospheric corrosion is found, take remedial measures to the extent required by the applicable paragraphs of §§ 192.485, 192.487, or 192.489; and

(3) Clean and either coat or jacket the areas of atmospheric corrosion on the pipeline with a material suitable for the prevention of atmospheric corrosion.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR App. A of Part 1)

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39390, Sept. 5, 1978]

§ 192.481 Atmospheric corrosion control: Monitoring.

After meeting the requirements of § 192.479 (a) and (b), each operator shall, at intervals not exceeding 3 years for onshore pipelines and at least once each calendar year, but with intervals not exceeding 15 months, for offshore pipelines, reevaluate each pipeline that is exposed to the atmosphere and take remedial action whenever necessary to maintain protection against atmospheric corrosion.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR App. A of Part 1)

[Amdt. 192-33, 43 FR 39390, Sept. 5, 1978]

§ 192.483 Remedial measures: General.

(a) Each segment of metallic pipe that replaces pipe removed from a buried or submerged pipeline because of external corrosion must have a properly prepared surface and must be provided with an external protective coating that meets the requirements of § 192.461.

(b) Each segment of metallic pipe that replaces pipe removed from a buried or submerged pipeline because of external corrosion must be cathodically protected in accordance with this subpart.

(c) Except for cast iron or ductile iron pipe, each segment of buried or submerged pipe that is required to be repaired because of external corrosion must be cathodically protected in accordance with this subpart.

§ 192.485 Remedial measures: Transmission lines.

(a) *General corrosion.* Each segment of transmission line with general corrosion and with a remaining wall thickness less than that required for the maximum allowable operating pressure of the pipeline must be replaced or the operating pressure reduced commensurate with the strength of the pipe based on actual remaining wall thickness. However, if the area of general corrosion is small, the corroded pipe may be repaired. Corrosion pitting so closely grouped as to affect the overall strength of the pipe is considered general corrosion for the purpose of this paragraph.

(b) *Localized corrosion pitting.* Each segment of transmission line pipe with localized corrosion pitting to a degree where leakage might result must be replaced or repaired, or the operating pressure must be reduced commensurate with the strength of the pipe, based on the actual remaining wall thickness in the pits.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR App. A of Part 1)

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39390, Sept. 5, 1978]

§ 192.487 Remedial measures: Distribution lines other than cast iron or ductile iron lines.

(a) *General corrosion.* Except for cast iron or ductile iron pipe, each segment of generally corroded distribution line pipe with a remaining wall thickness less than that required for the maximum allowable operating pressure of the pipeline, or a remaining wall thickness less than 30 percent of the nominal wall thickness, must be replaced. However, if the area of general corrosion is small, the corroded pipe may be repaired. Corrosion pitting so closely grouped as to affect the overall strength of the pipe is considered general corrosion for the purpose of this paragraph.

(b) *Localized corrosion pitting.* Except for cast iron or ductile iron pipe, each segment of distribution line pipe with localized corrosion pitting to a degree where leakage might result must be replaced or repaired.

§ 192.489 Remedial measures: Cast iron and ductile iron pipelines.

(a) *General graphitization.* Each segment of cast iron or ductile iron pipe on which general graphitization is found to a degree where a fracture or any leakage might result, must be replaced.

(b) *Localized graphitization.* Each segment of cast iron or ductile iron pipe on which localized graphitization is found to a degree where any leakage might result, must be replaced or repaired, or sealed by internal sealing methods adequate to prevent or arrest any leakage.

§ 192.491 Corrosion control records.

(a) Each operator shall maintain records or maps to show the location of cathodically protected piping, cathodic protection facilities, other than unrecorded galvanic anodes installed before August 1, 1971, and neighboring structures bonded to the cathodic protection system.

(b) Each of the following records must be retained for as long as the pipeline remains in service:

(1) Each record or map required by paragraph (a) of this section.

(2) Records of each test, survey, or inspection required by this subpart, in sufficient detail to demonstrate the adequacy of corrosion control measures or that a corrosive condition does not exist.

(49 U.S.C. 1672; 49 U.S.C. 1804; 49 CFR App. A of Part 1)

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39390, Sept. 5, 1978]

Subpart J—Test Requirements

§ 192.501 Scope.

This subpart prescribes minimum leak-test and strength-test requirements for pipelines.

§ 192.503 General requirements.

(a) No person may operate a new segment of pipeline, or return to service a segment of pipeline that has been relocated or replaced, until—

(1) It has been tested in accordance with this subpart to substantiate the

proposed maximum allowable operating pressure; and

(2) Each potentially hazardous leak has been located and eliminated.

(b) The test medium must be liquid, air, natural gas, or inert gas that is—

(1) Compatible with the material of which the pipeline is constructed;

(2) Relatively free of sedimentary materials; and

(3) Except for natural gas, nonflammable.

(c) Except as provided in § 192.505(a), if air, natural gas, or inert gas is used as the test medium, the following maximum hoop stress limitations apply:

Class location	Maximum hoop stress allowed as percentage of SMYS	
	Natural gas	Air or inert gas
1	80	80
2	30	75
3	30	50
4	30	40

(d) Each weld used to tie-in a test segment of pipeline is excepted from the test requirements of this subpart.

§ 192.505 Strength test requirements for steel pipeline to operate at a hoop stress of 30 percent or more of SMYS.

(a) Except for service lines, each segment of a steel pipeline that is to operate at a hoop stress of 30 percent or more of SMYS must be strength tested in accordance with this section to substantiate the proposed maximum allowable operating pressure. In addition, in a Class 1 or Class 2 location, if there is a building intended for human occupancy within 300 feet of a pipeline, a hydrostatic test must be conducted to a test pressure of at least 125 percent of maximum operating pressure on that segment of the pipeline within 300 feet of such a building, but in no event may the test section be less than 600 feet unless the length of the newly installed or relocated pipe is less than 600 feet. However, if the buildings are evacuated while the hoop stress exceeds 50 percent of SMYS, air or inert gas may be used as the test medium.

(b) In a Class 1 or Class 2 location, each compressor station, regulator station, and measuring station, must be tested to at least Class 3 location test requirements.

(c) Except as provided in paragraph (e) of this section, the strength test must be conducted by maintaining the pressure at or above the test pressure for at least 8 hours.

(d) If a component other than pipe is the only item being replaced or added to a pipeline, a strength test after installation is not required, if the manufacturer of the component certifies that—

(1) The component was tested to at least the pressure required for the pipeline to which it is being added; or

(2) The component was manufactured under a quality control system that ensures that each item manufactured is at least equal in strength to a prototype and that the prototype was tested to at least the pressure required for the pipeline to which it is being added.

(e) For fabricated units and short sections of pipe, for which a post installation test is impractical, a preinstallation strength test must be conducted by maintaining the pressure at or above the test pressure for at least 4 hours.

§ 192.507 Test requirements for pipelines to operate at a hoop stress less than 30 percent of SMYS and above 100 p.s.i.g.

Except for service lines and plastic pipelines, each segment of a pipeline that is to be operated at a hoop stress less than 30 percent of SMYS and above 100 p.s.i.g. must be tested in accordance with the following:

(a) The pipeline operator must use a test procedure that will ensure discovery of all potentially hazardous leaks in the segment being tested.

(b) If, during the test, the segment is to be stressed to 20 percent or more of SMYS and natural gas, inert gas, or air is the test medium—

(1) A leak test must be made at a pressure between 100 p.s.i.g. and the pressure required to produce a hoop stress of 20 percent of SMYS; or

(2) The line must be walked to check for leaks while the hoop stress is held at approximately 20 percent of SMYS.

(c) The pressure must be maintained at or above the test pressure for at least 1 hour.

§ 192.509 Test requirements for pipelines to operate at or below 100 p.s.i.g.

Except for service lines and plastic pipelines, each segment of a pipeline that is to be operated at or below 100 p.s.i.g. must be leak tested in accordance with the following:

(a) The test procedure used must ensure discovery of all potentially hazardous leaks in the segment being tested.

(b) Each main that is to be operated at less than 1 p.s.i.g. must be tested to at least 10 p.s.i.g. and each main to be operated at or above 1 p.s.i.g. must be tested to at least 90 p.s.i.g.

§ 192.511 Test requirements for service lines.

(a) Each segment of a service line (other than plastic) must be leak tested in accordance with this section before being placed in service. If feasible, the service-line connection to the main must be included in the test; if not feasible, it must be given a leakage test at the operating pressure when placed in service.

(b) Each segment of a service line (other than plastic) intended to be operated at a pressure of at least 1 p.s.i.g. but not more than 40 p.s.i.g. must be given a leak test at a pressure of not less than 50 p.s.i.g.

(c) Each segment of a service line (other than plastic) intended to be operated at pressures of more than 40 p.s.i.g. must be tested to at least 90 p.s.i.g., except that each segment of a steel service line stressed to 20 percent or more of SMYS must be tested in accordance with § 192.507 of this subpart.

§ 192.513 Test requirements for plastic pipelines.

(a) Each segment of a plastic pipeline must be tested in accordance with this section.

(b) The test procedure must insure discovery of all potentially hazardous leaks in the segment being tested.

(c) The test pressure must be at least 150 percent of the maximum operating pressure or 50 p.s.i.g., whichever is greater. However, the maximum test pressure may not be more than three times the design pressure of the pipe.

(d) The temperature of thermoplastic material must not be more than 100° F. during the test.

§ 192.515 Environmental protection and safety requirements.

(a) In conducting tests under this subpart, each operator shall insure that every reasonable precaution is taken to protect its employees and the general public during the testing. Whenever the hoop stress of the segment of the pipeline being tested will exceed 50 percent of SMYS, the operator shall take all practicable steps to keep persons not working on the testing operation outside of the testing area until the pressure is reduced to or below the proposed maximum allowable operating pressure.

(b) The operator shall insure that the test medium is disposed of in a manner that will minimize damage to the environment.

§ 192.517 Records.

Each operator shall make, and retain for the useful life of the pipeline, a record of each test performed under §§ 192.505 and 192.507. The record must contain at least the following information:

(a) The operator's name, the name of the operator's employee responsible for making the test, and the name of any test company used.

(b) Test medium used.

(c) Test pressure.

(d) Test duration.

(e) Pressure recording charts, or other record of pressure readings.

(f) Elevation variations, whenever significant for the particular test.

(g) Leaks and failures noted and their disposition.

Subpart K—Uprating

§ 192.551 Scope.

This subpart prescribes minimum requirements for increasing maximum allowable operating pressures (uprating) for pipelines.

§ 192.553 General requirements.

(a) *Pressure increases.* Whenever the requirements of this subpart require that an increase in operating pressure be made in increments, the pressure must be increased gradually, at a rate that can be controlled, and in accordance with the following:

(1) At the end of each incremental increase, the pressure must be held constant while the entire segment of pipeline that is affected is checked for leaks.

(2) Each leak detected must be repaired before a further pressure increase is made, except that a leak determined not to be potentially hazardous need not be repaired, if it is monitored during the pressure increase and it does not become potentially hazardous.

(b) *Records.* Each operator who uprates a segment of pipeline shall retain for the life of the segment a record of each investigation required by this subpart, of all work performed, and of each pressure test conducted, in connection with the uprating.

(c) *Written plan.* Each operator who uprates a segment of pipeline shall establish a written procedure that will ensure that each applicable requirement of this subpart is complied with.

(d) *Limitation on increase in maximum allowable operating pressure.* Except as provided in § 192.555(c), a new maximum allowable operating pressure established under this subpart may not exceed the maximum that would be allowed under this part for a new segment of pipeline constructed of the same materials in the same location.

§ 192.555 Uprating to a pressure that will produce a hoop stress of 30 percent or more of SMYS in steel pipelines.

(a) Unless the requirements of this section have been met, no person may subject any segment of a steel pipeline to an operating pressure that will produce a hoop stress of 30 percent or more of SMYS and that is above the established maximum allowable operating pressure.

(b) Before increasing operating pressure above the previously established maximum allowable operating pressure the operator shall—

(1) Review the design, operating, and maintenance history and previous testing of the segment of pipeline and determine whether the proposed increase is safe and consistent with the requirements of this part; and

(2) Make any repairs, replacements, or alterations in the segment of pipeline that are necessary for safe operation at the increased pressure.

(c) After complying with paragraph (b) of this section, an operator may increase the maximum allowable operating pressure of a segment of pipeline constructed before September 12, 1970, to the highest pressure that is permitted under § 192.619, using as test pressure the highest pressure to which the segment of pipeline was previously subjected (either in a strength test or in actual operation).

(d) After complying with paragraph (b) of this section, an operator that does not qualify under paragraph (c) of this section may increase the previously established maximum allowable operating pressure if at least one of the following requirements is met:

(1) The segment of pipeline is successfully tested in accordance with the requirements of this part for a new line of the same material in the same location.

(2) An increased maximum allowable operating pressure may be established for a segment of pipeline in a Class 1 location if the line has not previously been tested, and if—

(i) It is impractical to test it in accordance with the requirements of this part;

(ii) The new maximum operating pressure does not exceed 80 percent of that allowed for a new line of the same design in the same location; and

(iii) The operator determines that the new maximum allowable operating pressure is consistent with the condition of the segment of pipeline and the design requirements of this part.

(e) Where a segment of pipeline is uprated in accordance with paragraph (c) or (d)(2) of this section, the increase in pressure must be made in increments that are equal to—

(1) 10 percent of the pressure before the uprating; or

(2) 25 percent of the total pressure increase,

whichever produces the fewer number of increments.

§ 192.557 Uprating: Steel pipelines to a pressure that will produce a hoop stress less than 30 percent of SMYS: plastic, cast iron, and ductile iron pipelines.

(a) Unless the requirements of this section have been met, no person may subject—

(1) A segment of steel pipeline to an operating pressure that will produce a hoop stress less than 30 percent of SMYS and that is above the previously established maximum allowable operating pressure; or

(2) A plastic, cast iron, or ductile iron pipeline segment to an operating pressure that is above the previously established maximum allowable operating pressure.

(b) Before increasing operating pressure above the previously established maximum allowable operating pressure, the operator shall—

(1) Review the design, operating, and maintenance history of the segment of pipeline;

(2) Make a leakage survey (if it has been more than 1 year since the last survey) and repair any leaks that are found, except that a leak determined not to be potentially hazardous need not be repaired, if it is monitored during the pressure increase and it does not become potentially hazardous;

(3) Make any repairs, replacements, or alterations in the segment of pipeline that are necessary for safe operation at the increased pressure;

(4) Reinforce or anchor offsets, bends and dead ends in pipe joined by compression couplings or bell and spigot joints to prevent failure of the pipe joint, if the offset, bend, or dead end is exposed in an excavation;

(5) Isolate the segment of pipeline in which the pressure is to be increased from any adjacent segment that will continue to be operated at a lower pressure; and

(6) If the pressure in mains or service lines, or both, is to be higher than the pressure delivered to the customer, install a service regulator on each service line and test each regulator to determine that it is functioning. Pressure may be increased as necessary to test each regulator, after a regulator has been installed on each pipeline subject to the increased pressure.

(c) After complying with paragraph (b) of this section, the increase in maximum allowable operating pressure must be made in increments that are equal to 10 p.s.i.g. or 25 percent of the total pressure increase, whichever produces the fewer number of increments. Whenever the requirements of paragraph (b)(6) of this section apply, there must be at least two approximately equal incremental increases.

(d) If records for cast iron or ductile iron pipeline facilities are not complete enough to ascertain compliance with § 192.117 or § 192.119, as applicable, the following procedures must be followed:

(1) If the original laying conditions cannot be ascertained, the operator shall assume, when applying the design formulas of ANSI C101-67, that cast iron pipe was supported on blocks with tamped backfill and, when applying the design formulas of ANSI A21.50, that ductile iron pipe was laid without blocks with tamped backfill.

(2) Unless the actual maximum cover depth is known, the operator shall measure the actual cover in at least three places where the cover is most likely to be greatest and shall use the greatest cover measured.

(3) Unless the actual nominal wall thickness is known, the operator shall determine the wall thickness by cutting and measuring coupons from at least three separate pipe lengths. The coupons must be cut from pipe lengths in areas where the cover depth is most likely to be the greatest. The average of all measurements taken must be increased by the allowance indicated in the following table:

Pipe size (inches)	Allowance (inches)		
	Cast iron pipe		Ductile iron pipe
	Pit cast pipe	Centrifugally cast pipe	
3 to 8	0.075	0.065	0.065
10 to 12	0.08	0.07	0.07
14 to 24	0.08	0.08	0.075
30 to 42	0.09	0.09	0.075
48	0.09	0.09	0.08
54 to 60	0.09		

NOTE: The nominal wall thickness of the cast iron is the standard thickness listed in table 10 or table 11, as applicable, of ANSI C101-67 nearest the value obtained under this subparagraph. The nominal wall thickness of ductile iron pipe is the standard thickness listed in table 6 of ANSI A21.50 nearest the value obtained under this subparagraph.

(4) For cast iron pipe, unless the pipe manufacturing process is known, the operator shall assume that the pipe is pit case pipe with a bursting tensile strength of 11,000 p.s.i. and a modulus of rupture of 31,000 p.s.i.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-37, 46 FR 10160, Feb. 2, 1981]

Subpart L—Operations

§ 192.601 Scope.

This subpart prescribes minimum requirements for the operation of pipeline facilities.

§ 192.603 General provisions.

(a) No person may operate a segment of pipeline unless it is operated in accordance with this subpart.

(b) Each operator shall establish a written operating and maintenance plan meeting the requirements of this part and keep records necessary to administer the plan.

§ 192.605 Essentials of operating and maintenance plan.

Each operator shall include the following in its operating and maintenance plan:

(a) Instructions for employees covering operating and maintenance procedures during normal operations and repairs.

(b) Items required to be included by the provisions of Subpart M of this part.

(c) Specific programs relating to facilities presenting the greatest hazard to public safety either in an emergency or because of extraordinary construction or maintenance requirements.

(d) A program for conversion procedures, if conversion of a low-pressure distribution system to a higher pressure is contemplated.

(e) Provision for periodic inspections to ensure that operating pressures are appropriate for the class location.

§ 192.607 Initial determination of class location and confirmation or establishment of maximum allowable operating pressure.

(a) Before April 15, 1971, each operator shall complete a study to determine for each segment of pipeline with a maximum allowable operating pressure that will produce a hoop stress that is more than 40 percent of SMYS—

(1) The present class location of all such pipeline in its system; and

(2) Whether the hoop stress corresponding to the maximum allowable operating pressure for each segment of pipeline is commensurate with the present class location.

(b) Each segment of pipeline that has been determined under paragraph (a) of this section to have an established maximum allowable operating pressure producing a hoop stress that is not commensurate with the class location of the segment of pipeline and that is found to be in satisfactory condition, must have the maximum allowable operating pressure confirmed or revised in accordance with § 192.611. The confirmation or revision must be completed not later than December 31, 1974.

(c) Each operator required to confirm or revise an established maximum allowable operating pressure under paragraph (b) of this section shall, not later than December 31, 1971, prepare a comprehensive plan, including a schedule, for carrying out the confirmations or revisions. The comprehensive plan must also provide for confirmations or revisions determined to be necessary under § 192.609, to the extent that they are caused by changes in class locations taking place before July 1, 1973.

[35 FR 13257, Aug. 10, 1970, as amended by Amdt. 173-53, 36 FR 18194, Sept. 10, 1971]

§ 192.609 Change in class location: Required study.

Whenever an increase in population density indicates a change in class location for a segment of an existing steel pipeline operating at hoop stress that is more than 40 percent of SMYS, or indicates that the hoop stress corresponding to the established maximum allowable operating pressure for a segment of existing pipeline is not commensurate with the present class location, the operator shall immediately make a study to determine—

(a) The present class location for the segment involved.

(b) The design, construction, and testing procedures followed in the original construction, and a comparison of these procedures with those required for the present class location by the applicable provisions of this part.

(c) The physical condition of the segment to the extent it can be ascertained from available records;

(d) The operating and maintenance history of the segment;

(e) The maximum actual operating pressure and the corresponding operating hoop stress, taking pressure gradient into account, for the segment of pipeline involved; and

(f) The actual area affected by the population density increase, and physical barriers or other factors which may limit further expansion of the more densely populated area.

§ 192.611 Change in class location: Confirmation or revision of maximum allowable operating pressure.

If the hoop stress corresponding to the established maximum allowable operating pressure of a segment of pipeline is not commensurate with the present class location, and the segment is in satisfactory physical condition, the maximum allowable operating pressure of that segment of pipeline must be confirmed or revised as follows:

(a) If the segment involved has been previously tested in place to at least 90 percent of its SMYS for a period of not less than 8 hours, the maximum allowable operating pressure must be confirmed or reduced so that the corresponding hoop stress will not exceed 72 percent of SMYS of the pipe in Class 2 locations, 60 percent of SMYS in Class 3 locations, or 50 percent of SMYS in Class 4 locations.

(b) If the segment involved has not been previously tested in place as described in paragraph (a) of this section, the maximum allowable operating pressure must be reduced so that the corresponding hoop stress is not more than that allowed by this part for new segments of pipelines in the existing class location.

(c) If the segment of pipeline involved has not been qualified for operation under paragraph (a) or (b) of this section, it must be tested in accordance with the applicable requirements of Subpart J of this part, and its maximum allowable operating pressure must then be established so as to be equal to or less than the following:

(1) The maximum allowable operating pressure after the requalification test is 0.8 times the test pressure for Class 2 locations, 0.667 times the test pressure for Class 3 locations, and 0.555 times the test pressure for Class 4 locations.

(2) The maximum allowable operating pressure confirmed or revised in accordance with this section, may not exceed the maximum allowable operating pressure established before the confirmation or revision.

(3) The corresponding hoop stress may not exceed 72 percent of the SMYS of the pipe in Class 2 locations, 60 percent of SMYS in Class 3 locations, or 50 percent of the SMYS in Class 4 locations.

(d) Confirmation or revision of the maximum allowable operating pressure of a segment of pipeline in accordance with this section does not preclude the application of §§ 192.553 and 192.555.

(e) Confirmation or revision of the maximum allowable operating pressure that is required as a result of a study under § 192.609 must be completed as follows:

(1) Confirmation or revision due to changes in class location that occur before July 1, 1973, must be completed not later than December 31, 1974.

(2) Confirmation or revision due to changes in class location that occur on or after July 1, 1973, must be completed within 18 months of the change in class location.

(Natural Gas Pipeline Safety Act of 1968, 49 U.S.C. Sec. 1671 et seq.; Part 1, Regulations of the Office of the Secretary of Transportation, 49 CFR Part 1, delegation of authority to the Director, Office of Pipeline Safety, November 6, 1968 (33 FR 16468))

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-5, 36 FR 18195, Sept. 10, 1971]

§ 192.613 Continuing surveillance.

(a) Each operator shall have a procedure for continuing surveillance of its facilities to determine and take appropriate action concerning changes in class location, failures, leakage history, corrosion, substantial changes in cathodic protection requirements, and other unusual operating and maintenance conditions.

(b) If a segment of pipeline is determined to be in unsatisfactory condition but no immediate hazard exists, the operator shall initiate a program to recondition or phase out the segment involved, or, if the segment cannot be reconditioned or phased out, reduce the maximum allowable operating pressure in accordance with § 192.619 (a) and (b).

§ 192.615 Emergency plans.

(a) Each operator shall establish written procedures to minimize the hazard resulting from a gas pipeline emergency. At a minimum, the procedures must provide for the following:

(1) Receiving, identifying, and classifying notices of events which require immediate response by the operator.

(2) Establishing and maintaining adequate means of communication with appropriate fire, police, and other public officials.

(3) Prompt and effective response to a notice of each type of emergency, including the following:

(i) Gas detected inside or near a building.

(ii) Fire located near or directly involving a pipeline facility.

(iii) Explosion occurring near or directly involving a pipeline facility.

(iv) Natural disaster.

(4) The availability of personnel, equipment, tools, and materials, as needed at the scene of an emergency.

(5) Actions directed toward protecting people first and then property.

(6) Emergency shutdown and pressure reduction in any section of the operator's pipeline system necessary to minimize hazards to life or property.

(7) Making safe any actual or potential hazard to life or property.

(8) Notifying appropriate fire, police, and other public officials of gas pipeline emergencies and coordinating with them both planned responses and actual responses during an emergency.

(9) Safely restoring any service outage.

(10) Beginning action under § 192.617, if applicable, as soon after the end of the emergency as possible.

(b) Each operator shall—

(1) Furnish its supervisors who are responsible for emergency action a copy of that portion of the latest edition of the emergency procedures established under paragraph (a) of this section as necessary for compliance with those procedures.

(2) Train the appropriate operating personnel to assure that they are knowledgeable of the emergency procedures and verify that the training is effective.

(3) Review employee activities to determine whether the procedures were effectively followed in each emergency.

(c) Each operator shall establish and maintain liaison with appropriate fire, police, and other public officials to—

(1) Learn the responsibility and resources of each government organization that may respond to a gas pipeline emergency;

(2) Acquaint the officials with the operator's ability in responding to a gas pipeline emergency;

(3) Identify the types of gas pipeline emergencies of which the operator notifies the officials; and

(4) Plan how the operator and officials can engage in mutual assistance to minimize hazards to life or property.

(d) Each operator shall establish a continuing educational program to enable customers, the public, appropriate government organizations, and persons engaged in excavation related activities to recognize a gas pipeline emergency for the purpose of reporting it to the operator or the appropriate public officials. The program and the media used must be as comprehensive as necessary to reach all areas in which the operator transports gas. The program must be conducted in English and in other languages commonly understood by a significant number and concentration of the non-English speaking population in the operator's area.

[Amdt. 192-24, 41 FR 13587, Mar. 31, 1976]

§ 192.617 Investigation of failures.

Each operator shall establish procedures for analyzing accidents and failures, including the selection of samples of the failed facility or equipment for laboratory examination, where appropriate, for the purpose of determining the causes of the failure and minimizing the possibility of a recurrence.

§ 192.619 Maximum allowable operating pressure: Steel or plastic pipelines.

(a) Except as provided in paragraph (c) of this section, no person may operate a segment of steel or plastic pipeline at a pressure that exceeds the lowest of the following:

(1) The design pressure of the weakest element in the segment, determined in accordance with Subparts C and D of this part.

(2) The pressure obtained by dividing the pressure to which the segment was tested after construction as follows:

(i) For plastic pipe in all locations, the test pressure is divided by a factor of 1.5.

(ii) For steel pipe operated at 100 p.s.i.g. or more, the test pressure is divided by a factor determined in accordance with the following table:

Class location	Factors [1], segment—		
	Installed before (Nov. 12, 1970)	Installed after (Nov. 11, 1970)	Converted under § 192.14
1	1.1	1.1	1.25
2	1.25	1.25	1.25
3	1.4	1.5	1.5
4	1.4	1.5	1.5

[1] For offshore segments installed, uprated or converted after July 31, 1977, that are not located on an offshore platform, the factor is 1.25. For segments installed, uprated or converted after July 31, 1977, that are located on an offshore platform or on a platform in inland navigable waters, including a pipe riser, the factor is 1.5.

(3) The highest actual operating pressure to which the segment was subjected during the 5 years preceding July 1, 1970 (or in the case of offshore gathering lines, July 1, 1976), unless the segment was tested in accordance with paragraph (a)(2) of this section after July 1, 1965 (or in the case of offshore gathering lines, July 1, 1971), or the segment was uprated in accordance with Subpart K of this part.

(4) For furnace butt welded steel pipe, a pressure equal to 60 percent of the mill test pressure to which the pipe was subjected.

(5) For steel pipe other than furnace butt welded pipe, a pressure equal to 85 percent of the highest test pressure to which the pipe has been subjected, whether by mill test or by the post installation test.

(6) The pressure determined by the operator to be the maximum safe pressure after considering the history of the segment, particularly known corrosion and the actual operating pressure.

(b) No person may operate a segment to which paragraph (a)(6) of this section is applicable, unless over-pressure protective devices are installed on the segment in a manner that will prevent the maximum allowable operating pressure from being exceeded, in accordance with § 192.195.

(c) Notwithstanding the other requirements of this section, an operator may operate a segment of pipeline found to be in satisfactory condition, considering its operating and maintenance history, at the highest actual operating pressure to which the segment was subjected during the 5 years preceding July 1, 1970, or in the case of offshore gathering lines, July 1, 1976, subject to the requirements of § 192.611.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-1, 35 FR 17660, Nov. 17, 1970]

NOTE: For citations of additional amendments to § 192.619 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 192.621 Maximum allowable operating pressure: High-pressure distribution systems.

(a) No person may operate a segment of a high pressure distribution system at a pressure that exceeds the lowest of the following pressures, as applicable:

(1) The design pressure of the weakest element in the segment, determined in accordance with Subparts C and D of this part.

(2) 60 p.s.i.g., for a segment of a distribution system otherwise designed to operate at over 60 p.s.i.g., unless the service lines in the segment are equipped with service regulators or other pressure limiting devices in series that meet the requirements of § 192.197(c).

(3) 25 p.s.i.g. in segments of cast iron pipe in which there are unreinforced bell and spigot joints.

(4) The pressure limits to which a joint could be subjected without the possibility of its parting.

(5) The pressure determined by the operator to be the maximum safe pressure after considering the history of the segment, particularly known corrosion and the actual operating pressures.

(b) No person may operate a segment of pipeline to which paragraph (a)(5) of this section applies, unless overpressure protective devices are installed on the segment in a manner that will prevent the maximum allowable operating pressure from being exceeded, in accordance with § 192.195.

§ 192.623 Maximum and minimum allowable operating pressure: Low-pressure distribution systems.

(a) No person may operate a low-pressure distribution system at a pressure high enough to make unsafe the operation of any connected and properly adjusted low-pressure gas burning equipment.

(b) No person may operate a low pressure distribution system at a pressure lower than the minimum pressure at which the safe and continuing operation of any connected and properly adjusted low-pressure gas burning equipment can be assured.

§ 192.625 Odorization of gas.

(a) A combustible gas in a distribution line must contain a natural odorant or be odorized so that at a concentration in air of one-fifth of the lower explosive limit, the gas is readily detectable by a person with a normal sense of smell.

(b) After December 31, 1976, a combustible gas in a transmission line in a Class 3 or Class 4 location must comply with the requirements of paragraph (a) of this section unless—

(1) At least 50 percent of the length of the line downstream from that location is in a Class 1 or Class 2 location;

(2) The line transports gas to any of the following facilities which received gas without an odorant from that line before May 5, 1975;

(i) An underground storage field;

(ii) A gas processing plant;

(iii) A gas dehydration plant; or

(iv) An industrial plant using gas in a process where the presence of an odorant—

(A) Makes the end product unfit for the purpose for which it is intended;

(B) Reduces the activity of a catalyst; or

(C) Reduces the percentage completion of a chemical reaction; or

(3) In the case of a lateral line which transports gas to a distribution center, at least 50 percent of the length of that line is in a Class 1 or Class 2 location.

(c) In the concentrations in which it is used, the odorant in combustible gases must comply with the following:

(1) The odorant may not be deleterious to persons, materials, or pipe.

(2) The products of combustion from the odorant may not be toxic when breathed nor may they be corrosive or harmful to those materials to which the products of combustion will be exposed.

(d) The odorant may not be soluble in water to an extent greater than 2.5 parts to 100 parts by weight.

(e) Equipment for odorization must introduce the odorant without wide variations in the level of odorant.

(f) Each operator shall conduct periodic sampling of combustible gases to assure the proper concentration of odorant in accordance with this section.

(g) The odorization requirements of Part 190 of this chapter, as in effect on August 12, 1970, must be complied with, in each State in which odorization of gas in transmission lines is required by that part, until the earlier of the following dates:

(1) January 1, 1977; or

(2) The date upon which the distribution companies in that State are odorizing gas in accordance with paragraphs (a) through (f) of this section.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-1, 35 FR 17335, Nov. 11, 1970]

NOTE: For citations to additional amendments to § 192.625 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

§ 192.627 Tapping pipelines under pressure.

Each tap made on a pipeline under pressure must be performed by a crew qualified to make hot taps.

§ 192.629 Purging of pipelines.

(a) When a pipeline is being purged of air by use of gas, the gas must be released into one end of the line in a moderately rapid and continuous flow. If gas cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the gas.

(b) When a pipeline is being purged of gas by use of air, the air must be released into one end of the line in a moderately rapid and continuous flow. If air cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the air.

Subpart M—Maintenance

§ 192.701 Scope.

This subpart prescribes minimum requirements for maintenance of pipeline facilities.

§ 192.703 General.

(a) No person may operate a segment of pipeline, unless it is maintained in accordance with this subpart.

(b) Each segment of pipeline that becomes unsafe must be replaced, repaired, or removed from service.

(c) Hazardous leaks must be repaired promptly.

§ 192.705 Transmission lines: Patrolling.

(a) Each operator shall have a patrol program to observe surface conditions on and adjacent to the transmission line right-of-way for indications of leaks, construction activity, and other factors affecting safety and operation.

(b) The frequency of patrols is determined by the size of the line, the operating pressures, the class location, terrain, weather, and other relevant factors, but intervals between patrols may not be longer than prescribed in the following table:

Class location of line	Maximum interval between patrols	
	At highway and railroad crossings	At all other places
1, 2	6 months	1 year.
3	3 months	6 months.
4	do	3 months.

[Amdt. 192-21, 40 FR 20283, May 9, 1975]

§ 192.706 Transmission lines: Leakage surveys.

(a) Each operator of a transmission line shall provide for periodic leakage surveys of the line in its operating and maintenance plan.

(b) Leakage surveys of a transmission line must be conducted at intervals not exceeding 1 year. However, in the case of a transmission line which transports gas in conformity with § 192.625 without an odor or odorant, leakage surveys using leak detector equipment must be conducted—

(1) In Class 3 locations, at intervals not exceeding 6 months; and

(2) In Class 4 locations, at intervals not exceeding 3 months.

[Amdt. 192-21, 40 FR 20283, May 9, 1975]

§ 192.707 Line markers for mains and transmission lines.

(a) *Buried pipelines.* Except as provided in paragraph (b) of this section, a line marker must be placed and maintained as close as practical over each buried main and transmission line—

(1) At each crossing of a public road, railroad, and navigable waterway; and

(2) Wherever necessary to identify the location of the transmission line or main to reduce the possibility of damage or interference.

However, until January 1, 1978, paragraphs (a)(1) and (2) of this section do not apply to mains installed before April 21, 1975, and until January 1, 1978, paragraph (a)(1) of this section does not apply to transmission lines installed before April 21, 1975.

(b) *Exceptions for buried pipelines.* Line markers are not required for buried mains and transmission lines—

(1) Located offshore or under inland navigable waters;

(2) In Class 3 or Class 4 locations—

(i) Where placement of a marker is impractical; or

(ii) Where a program for preventing interference with underground pipelines is established by law; or

(3) In the case of navigable waterway crossings, within 100 feet of a line marker placed and maintained at that waterway in accordance with this section.

(c) *Pipelines aboveground.* Line markers must be placed and maintained along each section of a main and transmission line that is located aboveground in an area accessible to the public.

(d) *Markers other than at navigable waterways.* The following must be written legibly on a background of sharply contrasting color on each line marker not placed at a navigable waterway:

(1) The word "Warning," "Caution," or "Danger" followed by the words "Gas (or name of gas transported) Pipeline" all of which, except for markers in heavily developed urban areas, must be in letters at least one inch high with one-quarter inch stroke.

(2) The name of the operator and the telephone number (including area code) where the operator can be reached at all times.

(e) *Markers at navigable waterways.* Each line marker at a navigable waterway must have the following characteristics:

(1) A sign, rectangular in shape, with a narrow strip along each edge colored international orange and the area between lettering on the sign and boundary strips colored white.

(2) Written on the sign in block style, black letters—

(i) The word "Warning," "Caution," or "Danger," followed by the words "Do Not Anchor or Dredge" and the words "Gas (or name of gas transported) Pipeline Crossing"; and

(ii) The name of the operator and the telephone number (including area code) where the operator can be reached at all times.

(3) In overcast daylight, the sign is visible and the writing required by paragraph (e)(2)(i) of this section is legible, from approaching or passing vessels that may damage or interfere with the pipeline.

(f) *Existing markers.* Line markers installed before April 21, 1975, which do not comply with paragraph (d) or (e) of this section may be used until January 1, 1980.

(Sec. 3, Pub. L. 90-481, 82 Stat. 721, Natural Gas Pipeline Safety Act of 1968 (49 U.S.C. 1672); sec. 1.58(d) of the regulations of the Office of the Secretary of Transportation (49 CFR 1.58(d)), and the redelegation of authority to the Director, Office of Pipeline Safety, set forth in Appendix A to Part 1 of the regulations of the Office of the Secretary of Transportation (49 CFR Part 1), 1.53(a))

[Amdt. 192-20, 40 FR 13505, Mar. 27, 1975, as amended by Amdt. 192-27, 41 FR 34606, Aug. 16, 1976; 41 FR 39752, Sept. 16, 1976; Amdt. 192-20A, 41 FR 56808, Dec. 30, 1976]

§ 192.709 Transmission lines: Record keeping.

Each operator shall keep records covering each leak discovered, repair made, transmission line break, leakage survey, line patrol, and inspection, for as long as the segment of transmission line involved remains in service.

§ 192.711 Transmission lines: General requirements for repair procedures.

(a) Each operator shall take immediate temporary measures to protect the public whenever—

(1) A leak, imperfection, or damage that impairs its serviceability is found in a segment of steel transmission line operating at or above 40 percent of the SMYS; and

(2) It is not feasible to make a permanent repair at the time of discovery.

As soon as feasible, the operator shall make permanent repairs.

(b) Except as provided in § 192.717(a)(3), no operator may use a welded patch as a means of repair.

(49 U.S.C. 1672, 1804; 49 CFR 1.53, Appendix A of Part 1 and Appendix A of Part 106)

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-27B, 45 FR 3272, Jan. 17, 1980]

§ 192.713 Transmission lines: Permanent field repair of imperfections and damages.

(a) Except as provided in paragraph (b) of this section, each imperfection or damage that impairs the serviceability of a segment of steel transmission line operating at or above 40 percent of SMYS must be repaired as follows:

(1) If it is feasible to take the segment out of service, the imperfection or damage must be removed by cutting out a cylindrical piece of pipe and replacing it with pipe of similar or greater design strength.

(2) If it is not feasible to take the segment out of service, a full encirclement welded split sleeve of appropriate design must be applied over the imperfection or damage.

(3) If the segment is not taken out of service, the operating pressure must be reduced to a safe level during the repair operations.

(b) Submerged offshore pipelines and submerged pipelines in inland navigable waters may be repaired by mechanically applying a full encirclement split sleeve of appropriate design over the imperfection or damage.

[Amdt. 192-27, 41 FR 34607, Aug. 16, 1976]

§ 192.715 Transmission lines: Permanent field repair of welds.

Each weld that is unacceptable under § 192.241(c) must be repaired as follows:

(a) If it is feasible to take the segment of transmission line out of service, the weld must be repaired in accordance with the applicable requirements of § 192.245.

(b) A weld may be repaired in accordance with § 192.245 while the segment of transmission line is in service if—

(1) The weld is not leaking;

(2) The pressure in the segment is reduced so that it does not produce a stress that is more than 20 percent of the SMYS of the pipe; and

(3) Grinding of the defective area can be limited so that at least ⅛-inch thickness in the pipe weld remains.

(c) A defective weld which cannot be repaired in accordance with paragraph (a) or (b) of this section must be repaired by installing a full encirclement welded split sleeve of appropriate design.

§ 192.717 Transmission lines: Permanent field repair of leaks.

(a) Except as provided in paragraph (b) of this section, each permanent field repair of a leak on a transmission line must be made as follows:

(1) If feasible, the segment of transmission line must be taken out of service and repaired by cutting out a cylindrical piece of pipe and replacing it with pipe of similar or greater design strength.

(2) If it is not feasible to take the segment of transmission line out of service, repairs must be made by installing a full encirclement welded split sleeve of appropriate design, unless the transmission line—

(i) Is joined by mechanical couplings; and

(ii) Operates at less than 40 percent of SMYS.

(3) If the leak is due to a corrosion pit, the repair may be made by installing a properly designed bolt-on-leak

clamp; or, if the leak is due to a corrosion pit and on pipe of not more than 40,000 psi SMYS, the repair may be made by fillet welding over the pitted area a steel plate patch with rounded corners, of the same or greater thickness than the pipe, and not more than one-half of the diameter of the pipe in size.

(b) Submerged offshore pipelines and submerged pipelines in inland navigable waters may be repaired by mechanically applying a full encirclement split sleeve of appropriate design over the leak.

[Amdt. 192-27, 41 FR 34607, Aug. 16, 1976]

§ 192.719 Transmission lines: Testing of repairs.

(a) *Testing of replacement pipe.* (1) If a segment of transmission line is repaired by cutting out the damaged portion of the pipe as a cylinder, the replacement pipe must be tested to the pressure required for a new line installed in the same location.

(2) The test required by paragraph (a)(1) of this section may be made on the pipe before it is installed, but all field girth butt welds that are not strength tested must be tested after installation by nondestructive tests meeting the requirements of § 192.243.

(b) *Testing of repairs made by welding.* Each repair made by welding in accordance with §§ 192.713, 192.715, and 192.717 must be examined in accordance with § 192.241.

§ 192.721 Distribution systems: Patrolling.

(a) The frequency of patrolling mains must be determined by the severity of the conditions which could cause failure or leakage, and the consequent hazards to public safety.

(b) Mains in places or on structures where anticipated physical movement or external loading could cause failure or leakage must be patrolled at intervals not exceeding 3 months.

§ 192.723 Distribution systems: Leakage surveys and procedures.

(a) Each operator of a distribution system shall provide for periodic leakage surveys in its operating and maintenance plan.

(b) The type and scope of the leakage control program must be determined by the nature of the operations and the local conditions, but it must meet the following minimum requirements:

(1) A gas detector survey must be conducted in business districts, including tests of the atmosphere in gas, electric, telephone, sewer and water system manholes, at cracks in pavement and sidewalks, and at other locations providing an opportunity for finding gas leaks, at intervals not exceeding 1 year.

(2) Leakage surveys of the distribution system outside of the principal business areas must be made as frequently as necessary, but at intervals not exceeding 5 years.

§ 192.725 Test requirements for reinstating service lines.

(a) Except as provided in paragraph (b) of this section, each disconnected service line must be tested in the same manner as a new service line, before being reinstated.

(b) Each service line temporarily disconnected from the main must be tested from the point of disconnection to the service line valve in the same manner as a new service line, before reconnecting. However, if provisions are made to maintain continuous service, such as by installation of a bypass, any part of the original service line used to maintain continuous service need not be tested.

§ 192.727 Abandonment or inactivation of facilities.

(a) Each operator shall provide in its operating and maintenance plan for abandonment or deactivation of pipelines, including provisions for meeting each of the requirements of this section.

(b) Each pipeline abandoned in place must be disconnected from all sources and supplies of gas; purged of gas; in the case of offshore pipelines, filled with water or inert materials; and sealed at the ends. However, the pipeline need not be purged when the volume of gas is so small that there is no potential hazard.

(c) Except for service lines, each inactive pipeline that is not being maintained under this part must be disconnected from all sources and supplies of gas; purged of gas; in the case of offshore pipelines, filled with water or inert materials; and sealed at the ends. However, the pipeline need not be purged when the volume of gas is so small that there is no potential hazard.

(d) Whenever service to a customer is discontinued, one of the following must be complied with:

(1) The valve that is closed to prevent the flow of gas to the customer must be provided with a locking device or other means designed to prevent the opening of the value by persons other than those authorized by the operator.

(2) A mechanical device or fitting that will prevent the flow of gas must be installed in the service line or in the meter assembly.

(3) The customer's piping must be physically disconnected from the gas supply and the open pipe ends sealed.

(e) If air is used for purging, the operator shall insure that a combustible mixture is not present after purging.

(f) Each abandoned vault must be filled with a suitable compacted material.

[Amdt. 192-8, 37 FR 20695, Oct. 3, 1972, as amended by Amdt. 192-27, 41 FR 34607, Aug. 16, 1976]

§ 192.729 Compressor stations: Procedures for gas compressor units.

Each operator shall establish starting, operating, and shutdown procedures for gas compressor units.

§ 192.731 Compressor stations: Inspection and testing of relief devices.

(a) Except for rupture discs, each pressure relieving device in a compressor station must be inspected and tested in accordance with §§ 192.739 and 192.743, and must be operated periodically to determine that it opens at the correct set pressure.

(b) Any defective or inadequate equipment found must be promptly repaired or replaced.

(c) Each remote control shutdown device must be inspected and tested, at intervals not to exceed 1 year, to determine that it functions properly.

§ 192.733 Compressor stations: Isolation of equipment for maintenance or alterations.

Each operator shall establish procedures for maintaining compressor stations, including provisions for isolating units or sections of pipe and for purging before returning to service.

§ 192.735 Compressor stations: Storage of combustible materials.

(a) Flammable or combustible materials in quantities beyond those required for everyday use, or other than those normally used in compressor buildings, must be stored a safe distance from the compressor building.

(b) Aboveground oil or gasoline storage tanks must be protected in accordance with National Fire Protection Association Standard No. 30.

§ 192.737 Pipe-type and bottle-type holders: Plan for inspection and testing.

Each operator having a pipe-type or bottle-type holder shall establish a plan for the systematic, routine inspection and testing of these facilities, including the following:

(a) Provision must be made for detecting external corrosion before the strength of the container has been impaired.

(b) Periodic sampling and testing of gas in storage must be made to determine the dew point of vapors contained in the stored gas, that if condensed, might cause internal corrosion or interfere with the safe operation of the storage plant.

(c) The pressure control and pressure limiting equipment must be inspected and tested periodically to determine that it is in a safe operating condition and has adequate capacity.

§ 192.739 Pressure limiting and regulating stations: Inspection and testing.

Each pressure limiting station, relief device (except rupture discs), and pressure regulating station and its equipment must be subjected, at intervals not exceeding 1 year, to inspections and tests to determine that it is—

(a) In good mechanical condition;

(b) Adequate from the standpoint of capacity and reliability of operation for the service in which it is employed;

(c) Set to function at the correct pressure; and

(d) Properly installed and protected from dirt, liquids, or other conditions that might prevent proper operation.

§ 192.741 Pressure limiting and regulating stations: Telemetering or recording gages.

(a) Each distribution system supplied by more than one district pressure regulating station must be equipped with telemetering or recording pressure gages to indicate the gas pressure in the district.

(b) On distribution systems supplied by a single district pressure regulating station, the operator shall determine the necessity of installing telemetering or recording gages in the district, taking into consideration the number of customers supplied, the operating pressures, the capacity of the installation, and other operating conditions.

(c) If there are indications of abnormally high- or low-pressure, the regulator and the auxiliary equipment must be inspected and the necessary measures employed to correct any unsatisfactory operating conditions.

§ 192.743 Pressure limiting and regulating stations: Testing of relief devices.

(a) If feasible, pressure relief devices (except rupture discs) must be tested in place, at intervals not exceeding 1 year, to determine that they have enough capacity to limit the pressure on the facilities to which they are connected to the desired maximum pressure.

(b) If a test is not feasible, review and calculation of the required capacity of the relieving device at each station must be made, at intervals not exceeding one year, and these required capacities compared with the rated or experimentally determined relieving capacity of the device for the operating conditions under which it works.

(c) If the relieving device is of insufficient capacity, a new or additional device must be installed to provide the additional capacity required.

§ 192.745 Valve maintenance: Transmission lines.

Each transmission line valve that might be required during any emergency must be inspected and partially operated, at intervals not exceeding 1 year.

§ 192.747 Valve maintenance: Distribution systems.

Each valve, the use of which may be necessary for the safe operation of a distribution system, must be checked and serviced, at intervals not exceeding 1 year.

§ 192.749 Vault maintenance.

(a) Each vault housing pressure regulating and pressure limiting equipment, and having a volumetric internal content of 200 cubic feet or more, must be inspected, at intervals not exceeding 1 year, to determine that it is in good physical condition and adequately ventilated.

(b) If gas is found in the vault, the equipment in the vault must be inspected for leaks, and any leaks found must be repaired.

(c) The ventilating equipment must also be inspected to determine that it is functioning properly.

(d) Each vault cover must be inspected to assure that it does not present a hazard to public safety.

§ 192.751 Prevention of accidental ignition.

Each operator shall take steps to minimize the danger of accidental ignition of gas in any structure or area where the presence of gas constitutes a hazard of fire or explosion, including the following:

(a) When a hazardous amount of gas is being vented into open air, each potential source of ignition must be removed from the area and a fire extinguisher must be provided.

(b) Gas or electric welding or cutting may not be performed on pipe or on pipe components that contain a combustible mixture of gas and air in the area of work.

(c) Post warning signs, where appropriate.

§ 192.753 Caulked bell and spigot joints.

(a) Each cast-iron caulked bell and spigot joint that is subject to pressures of 25 p.s.i.g. or more must be sealed with:

(1) A mechanical leak clamp; or

(2) A material or device which—

(i) Does not reduce the flexibility of the joint;

(ii) Permanently bonds, either chemically or mechanically, or both, with the bell and spigot metal surfaces or adjacent pipe metal surfaces; and

(iii) Seals and bonds in a manner that meets the strength, environmental, and chemical compatibility requirements of §§ 192.53 (a) and (b) and 192.143.

(b) Each cast iron caulked bell and spigot joint that is subject to pressures of less than 25 p.s.i.g. and is exposed for any reason, must be sealed by a means other than caulking.

(Sec. 3, Pub. L. 90-481, 82 Stat. 721, 49 U.S.C. 1672; 40 FR 43901, 49 CFR 1.53)

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-25, 41 FR 23680, June 11, 1976]

§ 192.755 Protecting cast-iron pipelines.

When an operator has knowledge that the support for a segment of a buried cast-iron pipeline is disturbed:

(a) That segment of the pipeline must be protected, as necessary, against damage during the disturbance by:

(1) Vibrations from heavy construction equipment, trains, trucks, buses, or blasting;

(2) Impact forces by vehicles;

(3) Earth movement;

(4) Apparent future excavations near the pipeline; or

(5) Other foreseeable outside forces which may subject that segment of the pipeline to bending stress.

(b) As soon as feasible, appropriate steps must be taken to provide permanent protection for the disturbed segment from damage that might result from external loads, including compliance with applicable requirements of §§ 192.317(a), 192.319, and 192.361(b)-(d).

[Amdt. 192-23, 41 FR 13589, Mar. 31, 1976]

APPENDIX A—INCORPORATED BY REFERENCE

I. *List of organizations and address.*

A. American National Standards Institute (ANSI), 1430 Broadway, New York, N.Y. 10018.

B. American Petroleum Institute (API), 1801 K Street N.W., Washington, D.C. 20006 or 300 Corrigan Tower Building, Dallas, Tex. 75201.

C. The American Society of Mechanical Engineers (ASME), United Engineering Center, 345 East 47th Street, New York, N.Y. 10017.

D. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pa. 19103.

E. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 5203 Leesburg Pike, Suite 502, Falls Church, Va. 22041.

F. National Fire Protection Association (NFPA), 470 Atlantic Avenue, Boston, Massachusetts 02110.

II. *Documents incorporated by reference. Numbers in parentheses indicate applicable editions.*

A. American Petroleum Institute:

(1) API Specification 5A "API Specification for Casing, Tubing, and Drill Pipe" (1979).

(2) API Specification 6A "API Specification for Wellhead Equipment" (1979).

(3) API Specification 6D "API Specification for Pipeline Valves" (1977).

(4) API Specification 5L "API Specification for Line Pipe" (1980).

(5) API Specification 5LS "API Specification for Spiral-Weld Line Pipe" (1980).

(6) API Specification 5LX "API Specification for High-Test Line Pipe" (1980).

(7) API Recommended Practice 5LI "API Recommended Practice for Railroad Transportation of Line Pipe" (1972).

(8) API Standard 1104 "Standard for Welding Pipelines and Related Facilities" (1980).

B. The American Society for Testing and Materials:

(1) ASTM Specification A53 "Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless" (A53-79).

(2) ASTM Specification A106 "Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service" (A106-79b).

(3) ASTM Specification A134 "Standard Specification for Electric-Fusion (Arc)-Welded Steel Plate Pipe, Sizes 16 in. and over" (A134-74).

(4) ASTM Specification A135 "Standard Specification for Electric-Resistance-Welded Steel Pipe" (A135-79).

(5) ASTM Specification A139 "Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (Sizes 4 in. and over)" (A139-74).

(6) ASTM Specification A671 "Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures" (A671-77).

(7) ASTM Specification A672 "Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures" (A672-79).

(8) ASTM Specification A691 "Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures" (A691-79).

(9) ASTM Specification A211 "Standard Specification for Spiral-Welded Steel or Iron Pipe" (A211-75).

(10) ASTM Specification A333 "Standard Specification for Seamless and Welded Steel Pipe for Low Temperature Service" (A333-79).

(11) ASTM Specification A372 "Standard Specification for Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels" (A372-78).

(12) ASTM Specification A377 "Standard Specifications for Grey Iron and Ductile Iron Pressure Pipe" (A377-79).

(13) ASTM Specification A381 "Standard Specification for Metal-Arc-Welded Steel Pipe for use with High-Pressure Transmission Systems" (A381-79).

(14) ASTM Specification A539 "Standard Specification for Electric Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines" (A539-79).

(15) ASTM Specification B42 "Standard Specification for Seamless Copper Pipe, Standard Sizes" (B42-80).

(16) ASTM Specification B68 "Standard Specification for Seamless Copper Tube, Bright Annealed" (B68-80).

(17) ASTM Specification B75 "Standard Specification for Seamless Copper Tube" (B75-80).

(18) ASTM Specification B88 "Standard Specification for Seamless Copper Water Tube" (B88-80).

(19) ASTM Specification B251 "Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube" (B251-76).

(20) ASTM Specification D638 "Standard Test Method for Tensile Properties of Plastic" (D638-77a).

(21) ASTM Specification D2513 "Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings" (D2513-78ES).

(22) ASTM Specification D2517 "Standard Specification for Reinforced Epoxy Resin Gas Pressure Pipe and Fittings" (D2517-73) (Reapproved 1979).

C. The American National Standards Institute, Inc.:

(1) ANSI A21.11 "Rubber-Gasket Joints for Ductile-Iron, and Grey Iron Pressure Pipe and Fittings" (A21.11-1979).

(2) ANSI A21.50 "Thickness Design of Ductile-Iron Pipe" (1976).

(3) ANSI A21.52 "Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Gas" (1976).

(4) ANSI B16.1 "Cast-Iron Pipe Flanges and Flanged Fittings" (1975).

(5) ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings" (1977).

(6) ANSI B16.24 "Bronze Pipe Flanges and Flanged Fitting" (1979).

(7) ANSI B36.10 "Wrought Steel and Wrought Iron Pipe" (1979).

(8) ANSI C101-67 "Thickness Design of Cast-Iron Pipe" (C101-67-1977).

D. The American Society of Mechanical Engineers:

(1) ASME Boiler and Pressure Vessel Code, Section VIII "Pressure Vessels Division 1" (1977).

(2) ASME Boiler and Pressure Vessel Code, Section IX "Welding Qualifications" (1977).

E. Manufacturer's Standardization Society of the Valve and Fittings Industry:

(1) MSP SP-25 "Standard Marking System for Valves, Fittings, Flanges, and Union" (1978).

(2) MSS SP-44 "Steel Pipe Line Flanges" (1975).

(3) MSS SP-70 "Cast-Iron Gate Valves, Flanged and Threaded Ends" (1976).

(4) MSS SP-71 "Cast-Iron Swing Check Valves, Flanged and Threaded Ends" (1976).

(5) MSS SP-78 "Cast-Iron Plug Valves" (1977).

F. National Fire Protection Association:

(1) NFPA Standard 30 "Flammable and Combustible Liquids Code" (1977).

(2) NFPA Standard 58 "Standard for the Storage and Handling of Liquefied Petroleum Gases" (1979).

(3) NFPA Standard 59 "Standard for the Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants" (1979).

(4) NFPA Standard 59A "Storage and Handling Liquefied Natural Gas" (1979).

(5) "National Electrical Code" NFPA-70 (ANSI) (1978).

[Amdt. 192-37, 46 FR 10160, Feb. 2, 1981]

APPENDIX B—QUALIFICATION OF PIPE

I. *Listed Pipe Specifications.* Numbers in parentheses indicate applicable editions.

API 5L—Steel pipe (1980).
API 5LS—Steel pipe (1980).
API 5LX—Steel pipe (1980).
ASTM A53—Steel pipe (1979).
ASTM A106—Steel pipe (1979).
ASTM A134—Steel pipe (1974).
ASTM A135—Steel pipe (1979).
ASTM A139—Steel pipe (1974).
ASTM A211—Steel and iron pipe (1975).
ASTM A333—Steel pipe (1979).
ASTM A377—Cast iron pipe (1979).
ASTM A381—Steel pipe (1979).
ASTM A539—Steel tubing (1979).

ASTM Specification A671—Steel pipe (1977).
ASTM Specification A672—Steel pipe (1979).
ASTM Specification A691—Steel pipe (1979).
ASTM B42—Copper pipe (1980).
ASTM B68—Copper tubing (1980).
ASTM B75—Copper tubing (1980).
ASTM B88—Copper tubing (1980).
ASTM B251—Copper pipe and tubing (1976).
ASTM D2513—Thermoplastic pipe and tubing (1978).
ASTM D2517—Thermosetting plastic pipe and tubing (1973).
ANSI A21.52—Ductile iron pipe (1971).

II. *Steel pipe of unknown or unlisted specification.*

A. *Bending Properties.* For pipe 2 inches or less in diameter, a length of pipe must be cold bent through at least 90 degrees around a cylindrical mandrel that has a diameter 12 times the diameter of the pipe, without developing cracks at any portion and without opening the longitudinal weld.

For pipe more than 2 inches in diameter, the pipe must meet the requirements of the flattening tests set forth in ASTM A53, except that the number of tests must be at least equal to the minimum required in paragraph II-D of this appendix to determine yield strength.

B. *Weldability.* A girth weld must be made in the pipe by a welder who is qualified under Subpart E of this part. The weld must be made under the most severe conditions under which welding will be allowed in the field and by means of the same procedure that will be used in the field. On pipe more than 4 inches in diameter, at least one test weld must be made for each 100 lengths of pipe. On pipe 4 inches or less in diameter, at least one test weld must be made for each 400 lengths of pipe. The weld must be tested in accordance with API Standard 1104. If the requirements of API Standard 1104 cannot be met, weldability may be established by making chemical tests for carbon and manganese, and proceeding in accordance with section IX of the ASME Boiler and Pressure Vessel Code. The same number of chemical tests must be made as are required for testing a girth weld.

C. *Inspection.* The pipe must be clean enough to permit adequate inspection. It must be visually inspected to ensure that it is reasonably round and straight and there are no defects which might impair the strength or tightness of the pipe.

D. *Tensile Properties.* If the tensile properties of the pipe are not known, the minimum yield strength may be taken as 24,000 p.s.i.g. or less, or the tensile properties may be established by performing tensile tests as set forth in API Standard 5LX. All test specimens shall be selected at random and the following number of tests must be performed:

NUMBER OF TENSILE TESTS—ALL SIZES

10 lengths or less	1 set of tests for each length.
11 to 100 lengths	1 set of tests for each 5 lengths, but not less than 10 tests.
Over 100 lengths	1 set of tests for each 10 lengths, but not less than 20 tests.

If the yield-tensile ratio, based on the properties determined by those tests, exceeds 0.85, the pipe may be used only as provided in § 192.55(c).

III. *Steel pipe manufactured before November 12, 1970, to earlier editions of listed specifications.* Steel pipe manufactured before November 12, 1970, in accordance with a specification of which a later edition is listed in section I of this appendix, is qualified for use under this part if the following requirements are met:

A. *Inspection.* The pipe must be clean enough to permit adequate inspection. It must be visually inspected to ensure that it is reasonably round and straight and that there are no defects which might impair the strength or tightness of the pipe.

B. *Similarity of specification requirements.* The edition of the listed specification under which the pipe was manufactured must have substantially the same requirements with respect to the following properties as a later edition of that specification listed in section I of this appendix:

(1) Physical (mechanical) properties of pipe, including yield and tensile strength, elongation, and yield to tensile ratio, and testing requirements to verify those properties.

(2) Chemical properties of pipe and testing requirements to verify those properties.

C. *Inspection or test of welded pipe.* On pipe with welded seams, one of the following requirements must be met:

(1) The edition of the listed specification to which the pipe was manufactured must have substantially the same requirements with respect to nondestructive inspection of welded seams and the standards for acceptance or rejection and repair as a later edition of the specification listed in section I of this appendix.

(2) The pipe must be tested in accordance with Subpart J of this part to at least 1.25 times the maximum allowable operating pressure if it is to be installed in a class 1 location and to at least 1.5 times the maximum allowable operating pressure if it is to be installed in a class 2, 3, or 4 location. Notwithstanding any shorter time period permitted under Subpart J of this part, the test

pressure must be maintained for at least 8 hours.

(Sec. 3, Pub. L. 90-481, 82 Stat. 721, (49 U.S.C. 1672); for offshore gathering lines, sec. 105, Pub. L. 93-633, 88 Stat. 2157, (49 U.S.C. 1804); 49 CFR 1.53 and App. A to Part 1)

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-1, 35 FR 17661, Nov. 11, 1970]

NOTE: For citations of additional amendments to Appendix B of Part 192 see the List of CFR Sections Affected appearing in the Finding Aids section of this volume.

APPENDIX C—QUALIFICATION OF WELDERS FOR LOW STRESS LEVEL PIPE

I. *Basic test.* The test is made on pipe 12 inches or less in diameter. The test weld must be made with the pipe in a horizontal fixed position so that the test weld includes at least one section of overhead position welding. The beveling, root opening, and other details must conform to the specifications of the procedure under which the welder is being qualified. Upon completion, the test weld is cut into four coupons and subjected to a root bend test. If, as a result of this test, two or more of the four coupons develop a crack in the weld material, or between the weld material and base metal, that is more than ⅛-inch long in any direction, the weld is unacceptable. Cracks that occur on the corner of the specimen during testing are not considered.

II. *Additional tests for welders of service line connections to mains.* A service line connection fitting is welded to a pipe section with the same diameter as a typical main. The weld is made in the same position as it is made in the field. The weld is unacceptable if it shows a serious undercutting or if it has rolled edges. The weld is tested by attempting to break the fitting off the run pipe. The weld is unacceptable if it breaks and shows incomplete fusion, overlap, or poor penetration at the junction of the fitting and run pipe.

III. *Periodic tests for welders of small service lines.* Two samples of the welder's work, each about 8 inches long with the weld located approximately in the center, are cut from steel service line and tested as follows:

(1) One sample is centered in a guided bend testing machine and bent to the contour of the die for a distance of 2 inches on each side of the weld. If the sample shows any breaks or cracks after removal from the bending machine, it is unacceptable.

(2) The ends of the second sample are flattened and the entire joint subjected to a tensile strength test. If failure occurs adjacent to or in the weld metal, the weld is unacceptable. If a tensile strength testing machine is not available, this sample must also pass the bending test prescribed in subparagraph (1) of this paragraph.

APPENDIX D—CRITERIA FOR CATHODIC PROTECTION AND DETERMINATION OF MEASUREMENTS

I. *Criteria for cathodic protection—A. Steel, cast iron, and ductile iron structures.* (1) A negative (cathodic) voltage of at least 0.85 volt, with reference to a saturated copper-copper sulfate half cell. Determination of this voltage must be made with the protective current applied, and in accordance with sections II and IV of this appendix.

(2) A negative (cathodic) voltage shift of at least 300 millivolts. Determination of this voltage shift must be made with the protective current applied, and in accordance with sections II and IV of this appendix. This criterion of voltage shift applies to structures not in contact with metals of different anodic potentials.

(3) A minimum negative (cathodic) polarization voltage shift of 100 millivolts. This polarization voltage shift must be determined in accordance with sections III and IV of this appendix.

(4) A voltage at least as negative (cathodic) as that originally established at the beginning of the Tafel segment of the E-log-I curve. This voltage must be measured in accordance with section IV of this appendix.

(5) A net protective current from the electrolyte into the structure surface as measured by an earth current technique applied at predetermined current discharge (anodic) points of the structure.

B. *Aluminum structures.* (1) Except as provided in paragraphs (3) and (4) of this paragraph, a minimum negative (cathodic) voltage shift of 150 millivolts, produced by the application of protective current. The voltage shift must be determined in accordance with sections II and IV of this appendix.

(2) Except as provided in paragraphs (3) and (4) of this paragraph, a minimum negative (cathodic) polarization voltage shift of 100 millivolts. This polarization voltage shift must be determined in accordance with sections III and IV of this appendix.

(3) Notwithstanding the alternative minimum criteria in paragraphs (1) and (2) of this paragraph, aluminum, if cathodically protected at voltages in excess of 1.20 volts as measured with reference to a copper-copper sulfate half cell, in accordance with section IV of this appendix, and compensated for the voltage (IR) drops other than those across the structure-electrolyte boundary may suffer corrosion resulting from the build-up of alkali on the metal surface. A voltage in excess of 1.20 volts may

not be used unless previous test results indicate no appreciable corrosion will occur in the particular environment.

(4) Since aluminum may suffer from corrosion under high pH conditions, and since application of cathodic protection tends to increase the pH at the metal surface, careful investigation or testing must be made before applying cathodic protection to stop pitting attack on aluminum structures in environments with a natural pH in excess of 8.

C. *Copper structures.* A minimum negative (cathodic) polarization voltage shift of 100 millivolts. This polarization voltage shift must be determined in accordance with sections III and IV of this appendix.

D. *Metals of different anodic potentials.* A negative (cathodic) voltage, measured in accordance with section IV of this appendix, equal to that required for the most anodic metal in the system must be maintained. If amphoteric structures are involved that could be damaged by high alkalinity covered by paragraphs (3) and (4) of paragraph B of this section, they must be electrically isolated with insulating flanges, or the equivalent.

II. *Interpretation of voltage measurement.* Voltage (IR) drops other than those across the structure-electrolyte boundary must be considered for valid interpretation of the voltage measurement in paragraphs A(1) and (2) and paragraph B(1) of section I of this appendix.

III. *Determination of polarization voltage shift.* The polarization voltage shift must be determined by interrupting the protective current and measuring the polarization decay. When the current is initially interrupted, an immediate voltage shift occurs. The voltage reading after the immediate shift must be used as the base reading from which to measure polarization decay in paragraphs A(3), B(2), and C of section I of this appendix.

IV. *Reference half cells.* A. Except as provided in paragraphs B and C of this section, negative (cathodic) voltage must be measured between the structure surface and a saturated copper-copper sulfate half cell contacting the electrolyte.

B. Other standard reference half cells may be substituted for the saturated cooper-copper sulfate half cell. Two commonly used reference half cells are listed below along with their voltage equivalent to −0.85 volt as referred to a saturated copper-copper sulfate half cell:

(1) Saturated KCl calomel half cell: −0.78 volt.

(2) Silver-silver chloride half cell used in sea water: −0.80 volt.

C. In addition to the standard reference half cells, an alternate metallic material or structure may be used in place of the saturated copper-copper sulfate half cell if its potential stability is assured and if its voltage equivalent referred to a saturated copper-copper sulfate half cell is established.

[Amdt. 192-4, 36 FR 12305, June 30, 1971]

PART 193—LIQUEFIED NATURAL GAS FACILITIES: FEDERAL SAFETY STANDARDS

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APPENDIX A TO PART 193—INCORPORATION BY REFERENCE

AUTHORITY: 49 U.S.C. 1671 et seq.; 49 CFR 1.53, Appendix A of Part 1, and Appendix A of Part 106, unless otherwise noted.

SOURCE: 45 FR 9203, Feb. 11, 1980, unless otherwise noted.

Subpart A—General

§ 193.2001 Scope of part.

(a) This part prescribes safety standards for LNG facilities used in the transportation of gas by pipeline that is subject to the Natural Gas Pipeline Safety Act of 1968 and Part 192 of this chapter.

(b) This part does not apply to—

(1) LNG facilities used by ultimate consumers of LNG or natural gas.

(2) LNG facilities used in the course of natural gas treatment or hydrocarbon extraction which do not store LNG.

(3) In the case of a marine cargo transfer system and associated facilities, any matter other than siting pertaining to the system or facilities between the marine vessel and the last manifold (or in the absence of a manifold, the last valve) located immediately before a storage tank.

(4) Any LNG facility located in navigable waters (as defined in Section 3(8) of the Federal Power Act (16 U.S.C. 796(8)).

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-1, 45 FR 57418, Aug. 28, 1980]

§ 193.2003 Semisolid facilities.

An LNG facility used in the transportation or storage of LNG in a semisolid state need not comply with any requirement of this part which the Director finds impractical or unnecessary because of the semisolid state of LNG. In making such a finding, the Director may impose appropriate alternative safety conditions.

§ 193.2005 Applicability.

(a) New or amended standards in this part governing the siting, design, installation, or construction of an LNG facility and related personnel qualifications and training do not apply to—

(1) LNG facilities under construction before the date such standards are published; or

(2) LNG facilities for which an application for approval of the siting, construction, or operation was filed before March 1, 1978, with the Department of Energy (or any predecessor organization of that Department) or the appropriate State or local agency in the case of any facility not subject to the jurisdiction of the Department of Energy under the Natural Gas Act (not including any facility the construction of which began after November 29, 1979, not pursuant to such an approval).

(b) If an LNG facility listed in paragraph (a) of this section is replaced, relocated, or significantly altered after February 11, 1980, the replacement, relocated facility, or significantly altered facility must comply with the applicable requirements of this part governing siting, design, installation, and construction, except that—

(1) The siting requirements apply only to LNG storage tanks that are significantly altered by increasing the original storage capacity or relocated, not pursuant to an application for approval filed as provided by paragraph (a)(2) of this section before March 1, 1978; and

(2) To the extent compliance with the design, installation, and construction requirements would make the replaced, relocated, or altered facility incompatible with other facilities or would otherwise be impracticable, the replaced, relocated, or significantly altered facility may be designed, installed, or constructed in accordance with the original specifications for the facility, or in a manner that the Director finds acceptable.

(c) The siting, design, installation, and construction of an LNG facility under construction before February 11, 1980, or that is listed in paragraph (a)(2) of this section (except a facility under construction before July 1, 1976) must meet the applicable requirements of NFPA 59A (1972 edition) and Part 192 of this chapter or the applicable requirements of this part, except that no Part 192 standard issued after March 1, 1978, applies to an LNG facility listed in paragraph (a)(2) of this section.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-1, 45 FR 57418, Aug. 28, 1980; Amdt. 193-2, 45 FR 70404, Oct. 23, 1980]

§ 193.2007 Definitions.

As used in this part—

"Ambient vaporizer" means a vaporizer which derives heat from naturally occurring heat sources, such as the atmosphere, sea water, surface waters, or geothermal waters.

"Cargo transfer system" means a component, or system of components functioning as a unit, used exclusively for transferring hazardous fluids in bulk between a tank car, tank truck, or marine vessel and a storage tank.

"Component" means any part, or system of parts functioning as a unit, including, but not limited to, piping, processing equipment, containers, control devices, impounding systems, lighting, security devices, fire control equipment, and communication equipment, whose integrity or reliability is necessary to maintain safety in controlling, processing, or containing a hazardous fluid.

"Container" means a component other than piping that contains a hazardous fluid.

"Control system" means a component, or system of components functioning as a unit, including control valves and sensing, warning, relief, shutdown, and other control devices, which is activated either manually or automatically to establish or maintain the performance of another component.

"Controllable emergency" means an emergency where reasonable and prudent action can prevent harm to people or property.

"Design pressure" means the pressure used in the design of components for the purpose of determining the minimum permissible thickness or physical characteristics of its various parts. When applicable, static head shall be included in the design pressure to determine the thickness of any specific part.

"Determine" means make an appropriate investigation using scientific methods, reach a decision based on sound engineering judgment, and be able to demonstrate the basis of the decision.

"Dike" means the perimeter of an impounding space forming a barrier to prevent liquid from flowing in an unintended direction.

"Director" means Director of the Materials Transportation Bureau or any person to whom authority in the matter concerned has been delegated.

"Emergency" means a deviation from normal operation, a structural failure, or severe environmental conditions that probably would cause harm to people or property.

"Exclusion zone" means an area surrounding an LNG facility in which an operator or government agency legally controls all activities in accordance with § 193.2057 and § 193.2059 for as long as the facility is in operation.

"Fail-safe" means a design feature which will maintain or result in a safe condition in the event of malfunction or failure of a power supply, component, or control device.

"g" means the standard acceleration of gravity of 9.806 metre per second^2 (32.17 feet per second^2).

"Gas," except when designated as inert, means natural gas, other flammable gas, or gas which is toxic or corrosive.

"Hazardous fluid" means gas or hazardous liquid.

"Hazardous liquid" means LNG or a liquid that is flammable or toxic.

"Heated vaporizer" means a vaporizer which derives heat from other than naturally occurring heat sources.

"Impounding space" means a volume of space formed by dikes and floors which is designed to confine a spill of hazardous liquid.

"Impounding system" includes an impounding space, including dikes and floors for conducting the flow of spilled hazardous liquids to an impounding space.

"Liquefied natural gas" or "LNG" means natural gas or synthetic gas having methane (CH_4) as its major constituent which has been changed to a liquid or semisolid.

"LNG facility" means a pipeline facility that is used for liquefying or solidifying natural gas or synthetic gas or transferring, storing, or vaporizing liquefied natural gas.

"LNG plant" means an LNG facility or system of LNG facilities functioning as a unit.

"m^3" means a volumetric unit which is one cubic metre, 6.2898 barrels, 35.3147 ft.^{3}, or 264.1720 U.S. gallons, each volume being considered as equal to the other.

"Maximum allowable working pressure" means the maximum gage pressure permissible at the top of the equipment, containers or pressure vessels while operating at design temperature.

"Normal operation" means functioning within ranges of pressure, temperature, flow, or other operating criteria required by this part.

"Operator" means a person who owns or operates an LNG facility.

"Person" means any individual, firm, joint venture, partnership, corporation, association, state, municipality, cooperative association, or joint stock association and includes any trustee, receiver, assignee, or personal representative thereof.

"Pipeline facility" means new and existing piping, rights-of-way, and any equipment, facility, or building used in the transportation of gas or in the treatment of gas during the course of transportation.

"Piping" means pipe, tubing, hoses, fittings, valves, pumps, connections, safety devices or related components for containing the flow of hazardous fluids.

"Storage tank" means a container for storing a hazardous fluid, including an underground cavern.

"Transfer piping" means a system of permanent and temporary piping used for transferring hazardous fluids between any of the following: Liquefaction process facilities, storage tanks, vaporizers, compressors, cargo transfer systems, and facilities other than pipeline facilities.

"Transfer system" includes transfer piping and cargo transfer system.

"Vaporization" means an addition of thermal energy changing a liquid or semisolid to a vapor or gaseous state.

"Vaporizer" means a heat transfer facility designed to introduce thermal energy in a controlled manner for changing a liquid or semisolid to a vapor or gaseous state.

"Waterfront LNG plant" means an LNG plant with docks, wharves, piers, or other structures in, on, or immediately adjacent to the navigable waters of the United States or Puerto Rico and any shore area immediately adjacent to those waters to which vessels may be secured and at which LNG cargo operations may be conducted.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-1, 45 FR 57418, Aug. 28, 1980; Amdt. 193-2, 45 FR 70404, Oct. 23, 1980]

§ 193.2009 Rules of regulatory construction.

(a) As used in this part—

(1) "Includes" means including but not limited to;

(2) "May" means is permitted to or is authorized to;

(3) "May not" means is not permitted to or is not authorized to; and

(4) "Shall" or "must" is used in the mandatory and imperative sense.

(b) In this part—

(1) Words importing the singular include the plural; and

(2) Words importing the plural include the singular.

§ 193.2011 Reporting.

Leaks and spills of LNG must be reported in accordance with the requirements of Part 191 of this chapter.

§ 193.2013 Incorporation by reference.

(a) There are incorporated by reference in this part all materials referred to in this part that are not set forth in full. The incorporated materials are deemed published under 5 U.S.C. 552(a) and 1 CFR Part 51 and are part of this regulation as though set forth in full. All incorporated materials are listed in Appendix A to this Part 193 with the applicable editions in parentheses following the title of the referenced material. Only the latest listed edition applies, except that an earlier listed edition may be followed with respect to components which are designed, manufactured, or installed in accordance with the earlier edition before the latest edition is adopted, unless otherwise provided in this part. The incorporated materials are subject to change, but any change will be announced by publication in the FEDERAL REGISTER before it becomes effective.

(b) All incorporated materials are available for inspection in the Materials Transportation Bureau, U.S. Department of Transportation, 400 Seventh Street, SW., Washington, D.C. 20590, and at the Office of the Federal Register Library, 1100 L Street, NW., Washington, D.C. In addition, copies of the incorporated materials are available from the respective organizations listed in Appendix A to this Part 193.

(c) Incorporated by reference provisions approved by the Director of the Federal Register.

(49 U.S.C. 1674 (a); 49 CFR 1.53 and Appendix A to Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-2, 45 FR 70410, Oct. 23, 1980]

§ 193.2015 Petitions for finding or approval.

Where a rule in this part authorizes the Director to make a finding or approval, any operator may petition the Director to make such finding or approval. Petitions must be sent to the Director, Materials Transportation Bureau, 400 7th Street, SW., Washington, D.C. 20590, and be received at least 90 days before the operator requests that the finding or approval be made. Each petition must refer to the rule authorizing the action sought and contain information or arguments that justify the action. Unless otherwise specified, no public proceeding is held on a petition before it is granted or denied. Within 90 days after a petition is received, the Director notifies the petitioner of the disposition of the petition or, if the request requires more extensive consideration or additional information or comments are requested and delay is expected, of the date by which action will be taken.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[Amdt. 193-1, 45 FR 57418, Aug. 28, 1980]

§ 193.2017 Plans and procedures.

(a) Each operator shall maintain at each LNG plant the plans and procedures required for that plant by this part. The plans and procedures must be available upon request for review and inspection by the Director or any State Agency that has submitted a current certification or agreement with respect to the plant under section 5 of the Natural Gas Pipeline Safety Act of 1968 (49 U.S.C. 1674). In addition, each change to the plans or procedures must be available at the LNG plant for review and inspection within 20 days after the change is made.

(b) The Director or the State Agency, after notice and opportunity for hearing, may require the operator to amend its plans and procedures as necessary to provide a reasonable level of safety.

(49 U.S.C. 1674(a); 49 CFR 1.53 and Appendix A to Part 1)

[Amdt. 193-2, 45 FR 70404, Oct. 23, 1980]

Subpart B—Siting Requirements

§ 193.2051 Scope.

This subpart prescribes siting requirements for the following LNG facilities: Containers and their impounding systems, transfer systems and their impounding systems, emergency shutdown control systems, fire control systems, and associated foundations, support systems, and normal or auxiliary power facilities necessary to maintain safety.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[Amdt. 193-1, 45 FR 57418, Aug. 28, 1980]

§ 193.2055 General.

An LNG facility must be located at a site of suitable size, topography, and configuration so that the facility can be designed to minimize the hazards to persons and offsite property resulting from leaks and spills of LNG and other hazardous fluids at the site. In selecting a site, each operator shall determine all site-related characteristics which could jeopardize the integrity and security of the facility. A site must provide ease of access so that personnel, equipment, and materials from offsite locations can reach the site for fire fighting or controlling spill associated hazards or for evacuation of personnel.

§ 193.2057 Thermal radiation protection.

(a) *Thermal exclusion zone.* Each LNG container and LNG transfer system must have a thermal exclusion zone in accordance with the following:

(1) Within the thermal exclusion zone, the impounding system may not be located closer to targets listed in paragraph (d) of this section than the exclusion distance "d" determined according to this section, unless the target is a pipeline facility of the operator.

(2) If grading and drainage are used under § 193.2149(b), operators must comply with the requirements of this section by assuming the space needed for drainage and collection of spilled liquid is an impounding system.

(b) *Measurement.* The exclusion distance "d" is measured along the line (PT), as shown in the following impoundment diagram, where the following apply:

(1) T is a point on the target that is closest to (P).

(2) D is a point closest to (T) on the top inside edge of the innermost dike.

(3) θ is one of the following angles with the vertical, to account for flame tilt and potential preignition vapor formation:

(i) An assumed angle of $(\theta)=45°$; or

(ii) An angle determined in accordance with a mathematical model that meets the criteria of paragraph (c)(2) of this section, using the maximum wind speed that is exceeded less than 5 percent of the time based on recorded data for the area.

(4) L is one of the following lengths to account for flame height:

(i) An assumed length of $(L)=6(A/¶)^{0.5}$, where (A) is the horizontal area across the impounding space measured at the lowest point along the top inside edge of the dike; or

(ii) A length determined in accordance with a mathematical model that meets the criteria of paragraph (c)(2) of this section, using appropriate parameters consistent with the time period that a target could be subjected to exposure before harm would result.

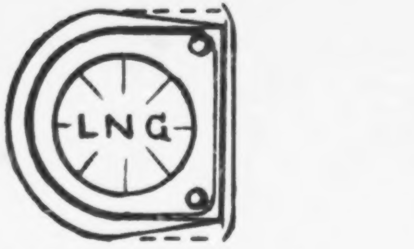
(5) PD is a line of length (L) or less, lying at angle θ in the vertical plane that intersects points (D) and (T).

(6) PT is a line lying in the vertical plane of line (PD), that:

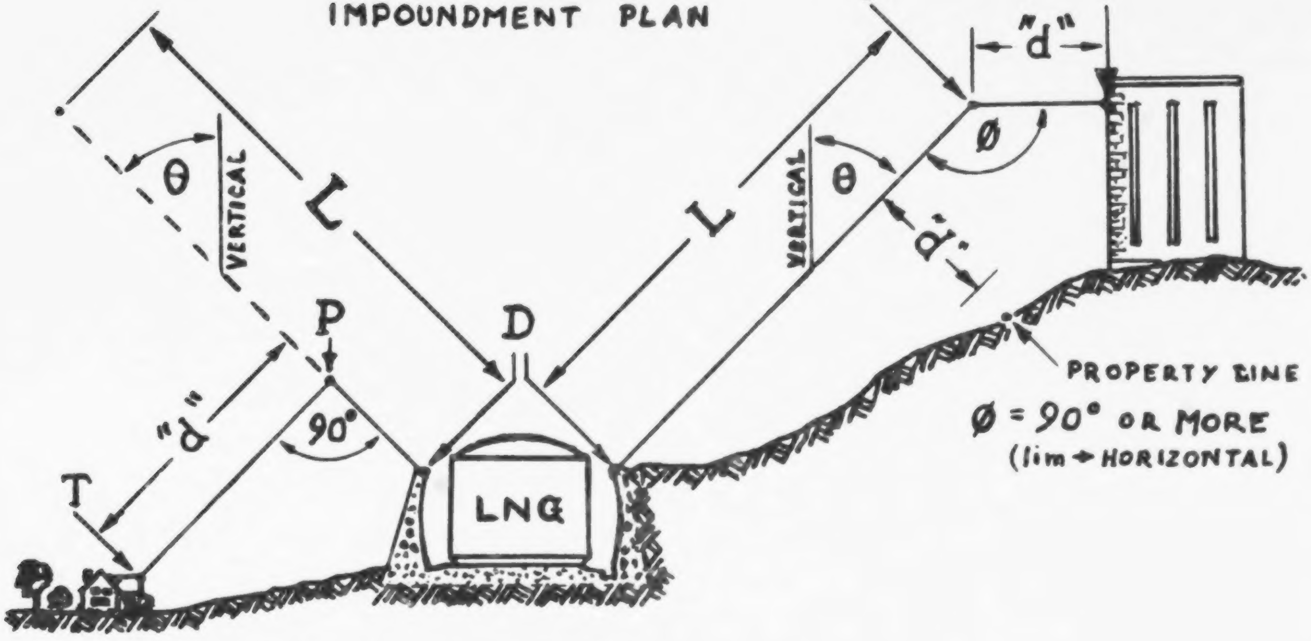
(i) Is perpendicular to line (PD) when (PD) is less than (L); or

(ii) Has an angular elevation not above the horizontal at (P) when (PD) equals (L);

(7) P is the point where (PT) and (PD) intersect.



IMPOUNDMENT PLAN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IMPOUNDMENT & TOPOGRAPHY ELEVATION PROFILE

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(c) *Exclusion distance length.* The length of an exclusion distance for each impounding space may not be less than the distance "d" determined in accordance with one of the following:

(1) $d=(f)(A)^{0.5}$, where

A=the largest horizontal area across the impounding space measured at the lowest point along the top inside edge of the dike.

f=values for targets prescribed in paragraph (d) of this section.

(2) Determine "d" from a mathematical model for thermal radiation and other appropriate fire characteristics which assures that the incident thermal flux levels in paragraph (d) of this section are not exceeded. The model must:

(i) Use atmospheric conditions which, if applicable, result in longer exclusion distances than other atmospheric conditions occurring at least 95 percent of the time based on recorded data for the site area;

(ii) Have been evaluated and verified by testing at a scale, considering scaling effects, appropriate for the range of application;

(iii) Have been submitted to the Director for approval, with supportive data as necessary to demonstrate validity; and

(iv) Have received approval by the Director.

(d) *Limiting values for incident radiant flux on offsite targets.* The maximum incident radiant flux at an offsite target from burning of a total spill in an impounding space must be limited to the distances in paragraph (c) of this section using the following values of "(f)" or "Incident Flux":

Offsite target	(f)	Incident flux Btu/ft.² hour
(1) Outdoor areas occupied by 20 or more persons during normal use, such as beaches, playgrounds, outdoor theaters, other recreation areas or other places of public assembly	(3)	1,600
(2) Buildings that are used for residences, or occupied by 20 or more persons during normal use	(1.6)	4,000
(3) Buildings made of cellulosic materials or are not fire resistant or do not provide durable shielding from thermal radiation that:		
(i) Have exceptional value, or contain objects of exceptional value based on historic uniqueness described in Federal, State, or local registers,		
(ii) Contain explosive, flammable, or toxic materials in hazardous quantities; or		
(iii) Could result in additional hazard if exposed to high levels of thermal radiation	(1.6)	4,000
(4) Structures that are fire resistant and provide durable shielding from thermal radiation that have the characteristics described in paragraphs (3)(i) through (3)(iii) above	(1.1)	6,700
(5) Public streets, highways, and mainlines of railroads—	(1.1)	6,700
(6) Other structures, or if closer to (P), the right-of-way line of the facility	(0.8)	10,000

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-1, 45 FR 57418, Aug. 28, 1980]

§ 193.2059 Flammable vapor-gas dispersion protection.

(a) *Dispersion exclusion zone.* Except as provided by paragraph (e) of this section, each LNG container and LNG transfer system must have a dispersion exclusion zone with a boundary described by the minimum dispersion distance computed in accordance with this section. The following are prohibited in a dispersion exclusion zone unless it is an LNG facility of the operator:

(1) Outdoor areas occupied by 20 or more persons during normal use, such as beaches, playgrounds, outdoor theaters, other recreation areas, or other places of public assembly.

(2) Buildings that are:

(i) Used for residences;

(ii) Occupied by 20 or more persons during normal use;

(iii) Contain explosive, flammable, or toxic materials in hazardous quantities;

(iv) Have exceptional value or contain objects of exceptional value based on historic uniqueness described in Federal, State, or local registers; or

(v) Could result in additional hazard if exposed to a vapor-gas cloud.

(b) *Measuring dispersion distance.* The dispersion distance is measured radially from the inside edge of an impounding system along the ground contour to the exclusion zone boundary.

(c) *Computing dispersion distance.* A minimum dispersion distance must be computed for the impounding system. If grading and drainage are used under § 193.2149(b), operators must comply with the requirements of this section by assuming the space needed for drainage and collection of spilled liquid is an impounding system. Dispersion distance must be determined in accordance with the following dispersion parameters, using applicable parts of the mathematical model in Appendix B of the report, "Evaluation of LNG Vapor Control Methods," 1974, or a model for vapor dispersion which meets the requirements of paragraphs (ii) through (iv) in § 193.2057(c)(2):

(1) Average gas concentration in air = 2.5 percent.

(2) Dispersion conditions are a combination of those which result in longer predicted downwind dispersion distances than other weather conditions at the site at least 90 percent of the time, based on U.S. Government weather data, or as an alternative where the model used gives longer distances at lower wind speeds, Category F atmosphere, wind speed = 4.5 miles per hour, relative humidity equals 50.0 percent, and atmospheric temperatures = 0.0 C.

(3) Dispersion coordinates y, z, and H, where applicable, = 0.

(d) *Vaporization design rate.* In computing dispersion distance under paragraph (c) of this section, the following applies:

(1) Vaporization results from the spill caused by an assumed rupture of a single transfer pipe (or multiple pipes that lack provisions to prevent parallel flow) which has the greatest overall flow capacity, discharging at maximum potential capacity, in accordance with the following conditions:

(i) The rate of vaporization is not less than the sum of flash vaporization and vaporization from boiling by heat transfer from contact surfaces during the time necessary for spill detection, instrument response, and automatic shutdown by the emergency shutdown system but, not less than 10 minutes, plus, in the case of impounding systems for LNG storage tanks with side or bottom penetrations, the time necessary for the liquid level in the tank to reach the level of the penetration or equilibrate with the liquid impounded assuming failure of the internal shutoff valve.

(ii) In determining variations in vaporization rate due to surface contact, the time necessary to wet 100 percent of the impounding floor area shall be determined by equation C-9 in the report "Evaluation of LNG Vapor Control Methods," 1974, or an alternate model which meets the requirements of paragraphs (ii) through (iv) in § 193.2057(c)(2).

(iii) After spill flow is terminated, the rate of vaporization is vaporization of the remaining spillage, if any, from boiling by heat transfer from contact surfaces that are reducing in area and temperature as a function of time.

(iv) Vapor detention space is all space provided for liquid impoundment and vapor detention outside the component served, less the volume occupied by the spilled liquid at the time the vapor escapes the vapor detention space.

(2) The boiling rate of LNG on which dispersion distance is based is determined using the weighted average value of the thermal properties of the contact surfaces in the impounding space determined from eight representative experimental tests on the materials involved. If surfaces are insulated, the insulation must be designed, installed, and maintained so that it will retain its performance characteristics under spill conditions.

(e) *Planned vapor control.* An LNG facility need not have a dispersion exclusion zone if the Director finds that compliance with paragraph (a) of this section would be impractical and the operator prepares and follows a plan for controlling LNG vapor that is found acceptable by the Director. The plan must include circumstances under which LNG vapor is controlled to preclude the dispersion of a flammable mixture from the LNG facility under all predictable environmental conditions that could adversely affect control. The reliability of the method of control must be demonstrated by testing or experience with LNG spills.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-1, 45 FR 57418, Aug. 28, 1980]

§ 193.2061 Seismic investigation and design forces.

(a) Except for shop fabricated storage tanks of 70,000 gallons or less capacity mounted within 2 feet of the ground, if an LNG facility is located at a site in Zone 0 or 1 of the "Seismic Risk Map of the United States," UBC, each operator shall determine, based on a study of faults, hydrologic regime, and soil conditions, whether a potential exists at the site for surface faulting or soil liquefaction.

(b) Subject to paragraph (f) of this section, LNG facilities must be designed and built to withstand, without loss of structural or functional integrity, the following seismic design forces, as applicable:

(1) For LNG facilities (other than shop fabricated storage tanks of 70,000 gallons or less capacity mounted within 2 feet of the ground) located at a site in Puerto Rico in Zone 2, 3, or 4 of the "Seismic Risk Map of the United States," or at a site determined under paragraph (a) of this section to have a potential for surface faulting or soil liquefaction, the forces that could reasonably be expected to occur at the foundation of the facility due to the most critical ground motion, motion amplification, permanent differential ground displacement, soil liquefaction, and symmetric and assymmetric reaction forces resulting from hydrodynamic pressure and motion of contained liquid in interaction with the facility structure.

(2) For all other LNG facilities, the total lateral force set forth in UBC, Volume 1, corresponding to the zone of the "Seismic Risk Map of the United States" in which the facility is located, and a vertical force equal to the total lateral force.

(c) Each operator of an LNG facility to which paragraph (b)(1) of this section applies shall determine the seismic design forces on the basis of a detailed geotechnical investigation and in accordance with paragraphs (d) and (e) of this section. The investigation must include each of the following items that could reasonably be expected to affect the site and be sufficient in scope to identify all hazards that could reasonably be expected to affect the facility design:

(1) Identification and evaluation of faults, Quaternary activity of those faults, tectonic structures, static and dynamic properties of materials underlying the site, and, as applicable, tectonic provinces within 100 miles of the site;

(2) Identification and evaluation of all historically reported earthquakes which could affect the determination under this section of the most critical ground motion or differential displacement at the site when correlated with particular faults, tectonic structures, and tectonic provinces, as applicable; and

(3) Identification and evaluation of the hydrologic regime and the potential of liquefaction-induced soil failures.

(d) The most critical ground motion must be determined in accordance with paragraph (e) of this section either:

(1) Probabilistically, when the available earthquake data are sufficient to show that the yearly probability of exceedance of most critical ground motion is 10^{-4} or less; or

(2) Deterministically, when the available earthquake data are insufficient to provide probabilistic estimates, with the objective of determining a most critical ground motion with a yearly probability of exceedance of 10^{-4} or less.

(e) The determination of most critical ground motion, considering local and regional seismological conditions, must be made by using the following:

(1) A regionally appropriate attenuation relationship, assuming that earthquakes occur at a location on a fault, tectonic structure, or tectonic province, as applicable, which would cause the most critical seismic move-

ment at the site, except that where epicenters of historically reported earthquakes cannot be reasonably related to known faults or tectonic structures, but are recognized as being within a specific tectonic province which is within 100 miles of the site, assume that those earthquakes occur within their respective provinces at a source closest to the site.

(2) A horizontal design response spectrum determined from the mean plus one standard deviation of a free-field horizontal elastic response spectra whose spectral amplitudes are consistent with values expected for the most critical ground motion.

(3) A vertical design response spectrum that is either two-thirds of the amplitude of the horizontal design response spectrum at all frequencies or equal to the horizontal design response spectrum where the site is located within 10 miles of the earthquake source.

(f) An LNG storage tank or its impounding system may not be located at a site where an investigation under paragraph (c) of this section shows that any of the following conditions exists unless the Director grants an approval for the site:

(1) The estimated design horizontal acceleration exceeds 0.8g at the tank or dike foundation.

(2) The specific local geologic and seismic data base is sufficient to predict future differential surface displacement beneath the tank and dike area, but displacement not exceeding 30 inches cannot be assured with a high level of confidence.

(3) The specific local geologic and seismic data base is not sufficient to predict future differential surface displacement beneath the tank and dike area, and the estimated cumulative displacement of a Quaternary fault within one mile of the tank foundation exceeds 60 inches.

(4) The potential for soil liquefaction cannot be accommodated by design and construction in accordance with paragraph (b)(1) of this section.

(g) An application for approval of a site under paragraph (f) of this section must provide at least the following:

(1) A detailed analysis and evaluation of the geologic and seismic characteristics of the site based on the geotechnical investigation performed under paragraph (c) of this section, with emphasis on prediction of near-field seismic response.

(2) The design plans and structural analysis for the tank, its impounding system, and related foundations, with a report demonstrating that the design requirements of this section are satisfied, including any test results or other documentation as appropriate.

(3) A description of safety-related features of the site or designs, in addition to those required by this part, if applicable, that would mitigate the potential effects of a catastrophic spill (e.g., remoteness or topographic features of the site, additional exclusion distances, or multiple barriers for containing or impounding LNG).

(h) Each container which does not have a structurally liquid-tight cover must have sufficient freeboard with an appropriate configuration to prevent the escape of liquid due to sloshing, wave action, and vertical liquid displacement caused by seismic action.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-1, 45 FR 57419, Aug. 28, 1980]

§ 193.2063 Flooding.

(a) Each operator shall determine the effects of flooding on an LNG facility site based on the worst occurrence in a 100-year period. The determination must take into account:

(1) Volume and velocity of the floodwater;

(2) Tsunamis (local, regional, and distant);

(3) Potential failure of dams;

(4) Predictable land developments which would affect runoff accumulation of water; and

(5) Tidal action.

(b) The effect of flooding determined under paragraph (a) of this section must be accommodated by location or design and construction, as applicable, to reasonably assure:

(1) The structural or functional integrity of LNG facilities; and

(2) Access from outside the LNG facility and movement of personnel and equipment about the LNG facility site

for the control of fire and other emergencies.

§ 193.2065 Soil characteristics.

(a) Soil investigations including borings and other appropriate tests must be made at the site of each LNG facility to determine bearing capacity, settlement characteristics, potential for erosion, and other soil characteristics applicable to the integrity of the facility.

(b) The naturally occurring or designed soil characteristics at each LNG facility site must provide load bearing capacities, using appropriate safety factors, which can support the following loads without excessive lateral or vertical movement that causes a loss of the functional or structural integrity of the facility involved:

(1) Static loading caused by the facility and its contents and any hydrostatic testing of the facility; and

(2) Dynamic loading caused by movement of contents of the facility during normal operation, including flow, sloshing, and rollover.

§ 193.2067 Wind forces.

(a) LNG facilities must be designed to withstand without loss of structural or functional integrity:

(1) The direct effect of wind forces;

(2) The pressure differential between the interior and exterior of a confining, or partially confining, structure; and

(3) In the case of impounding systems for LNG storage tanks, impact forces and potential penetrations by wind borne missiles.

(b) The wind forces at the location of the specific facility must be based on one of the following:

(1) For shop fabricated containers of LNG or other hazardous fluids with a capacity of not more than 70,000 gallons, applicable wind load data in ANSI A 58.1, 1972 edition.

(2) For all other LNG facilities—

(i) An assumed sustained wind velocity of not less than 200 miles per hour, unless the Director finds a lower velocity is justified by adequate supportive data; or

(ii) The most critical combination of wind velocity and duration, with respect to the effect on the structure, having a probability of exceedance in a 50-year period of 0.5 percent or less, if adequate wind data are available and the probabilistic methodology is reliable.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-1, 45 FR 57419, Aug. 28, 1980]

§ 193.2069 Other severe weather and natural conditions.

(a) In addition to the requirements of §§ 193.2061, 193.2063, 193.2065, and 193.2067, each operator shall determine from historical records and engineering studies the worst effect of other weather and natural conditions which may predictably occur at an LNG facility site.

(b) The facility must be located and designed so that such severe conditions cannot reasonably be expected to result in an emergency involving the factors listed in § 193.2063(b).

§ 193.2071 Adjacent activities.

(a) Each operator shall determine that present and reasonably foreseeable activities adjacent to an LNG facility site that could adversely affect the operation of the LNG facility or the safety of persons or offsite property, if damage to the facility occurs.

(b) An LNG facility must not be located where present or projected offsite activities would be reasonably expected to—

(1) Adversely affect the operation of any of its safety control systems;

(2) Cause failure of the facility; or

(3) Cause the facility not to meet the requirements of this part.

§ 193.2073 Separation of facilities.

Each LNG facility site must be large enough to provide for minimum separations between facilities and between facilities and the site boundary to—

(a) Permit movement of personnel, maintenance equipment, and emergency equipment around the facility; and

(b) Comply with distances specified in sections 2-2.4 through 2-2.7 of NFPA 59A.

Subpart C—Design

§ 193.2101 Scope.

This subpart prescribes requirements for the selection and qualification of materials for components, and for the design and installation or construction of components and buildings, including separate requirements for impounding systems, LNG storage tanks, and transfer systems.

MATERIALS

§ 193.2103 General.

Materials for all components must be—

(a) Able to maintain their structural integrity under all design loadings, including applicable environmental design forces under Subpart B of this part;

(b) Physically, chemically, and thermally compatible within design limits with any fluid or other materials with which they are in contact; and

(c) Qualified in accordance with the applicable requirements of this subpart.

§ 193.2105 Extreme temperatures; normal operations.

Each operator shall—

(a) Determine the range of temperatures to which components will be subjected during normal operations, including required testing, initial startup, cooldown operations, and shutdown conditions; and

(b) Use component materials that meet the design standards of this part for strength, ductility, and other properties throughout the entire range of temperatures to which the component will be subjected in normal operations.

§ 193.2107 Extreme temperatures, emergency conditions.

(a) Each operator shall determine the effects on components not normally exposed to extreme cold (including a component's foundation or support system) of contact by LNG or cold refrigerant that could result from error, a spill, or other emergency determined as required by this part.

(b) Each operator shall determine the effects on components (including their foundations or support systems) of the extreme heat which could result from an LNG or other hazardous fluid fire.

(c) Where the exposure determined under paragraph (a) or (b) of this section could result in a failure that would worsen the emergency, the component or its foundation or support system, as appropriate, must be:

(1) Made of material or constructed to be suitable for the extreme temperature to which it could be subjected; or

(2) Protected by insulation or other means that will delay failure due to extreme temperature in order to allow adequate time to take emergency responses.

(d) If a material that has low resistance to flame temperatures is used in any component containing a hazardous fluid, the material must be protected so that any heat resulting from a controllable emergency does not cause the release of fluid that would result in an uncontrollable emergency.

§ 193.2109 Insulation.

During normal operations, insulation materials must—

(a) Maintain insulating values;

(b) Withstand thermal and mechanical design loads; and

(c) Be covered with a material that is noncombustible in the installed state, is not subject to detrimental ultraviolet decay, and that can withstand the forces of wind according to ANSI A58.1 and anticipated loading which could occur in a controllable emergency.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-1, 45 FR 57419, Aug. 28, 1980]

§ 193.2111 Cold boxes.

All cold boxes must be made of noncombustible material and the insulation must be made of materials which are noncombustible in the installed condition.

§ 193.2113 Piping.

(a) Piping made of cast iron, malleable iron, or ductile iron may not be used to carry any cryogenic or hazardous fluids.

(b) Piping materials intended for normal use at temperatures below −28.9° C (−20° F) or for use under § 193.2107(c)(1) must be qualified by testing in accordance with ANSI B 31.3 to comply with § 193.2103(b).

§ 193.2115 Concrete subject to cryogenic temperatures.

Concrete intended for normal use at cryogenic temperatures or for use under § 193.2107(c)(1) may not be used unless—

(a) Materials, measurements, mixing, placing, prestressing, and post-stressing of concrete meets generally accepted engineering practices;

(b) Metallic reinforcing, prestressing wire, structural and nonstructural members used in concrete are acceptable in the installed condition for the temperature and stress levels encountered at design loading conditions; and

(c) Tests for the compressive strength, the coefficient of contraction, an acceptable thermal gradient, and, if applicable, acceptable surface loading to prevent detrimental spalling are performed on the concrete at the lowest temperature for which the concrete is designed or similar test data on these properties are available.

§ 193.2117 Combustible materials.

Combustible materials are not permitted for the construction of buildings, plant equipment, and the foundations and supports of buildings and plant equipment in areas where ignition of the material would worsen an emergency. However, limited combustible materials may be used when the use of noncombustible materials is impractical.

§ 193.2119 Records

Each operator shall keep a record of all materials for components, buildings, foundations, and support systems, as necessary to verify that material properties meet the requirements of this part. These records must be maintained for the life of the item concerned.

EFFECTIVE DATE NOTE: At 45 FR 9184-9185, Feb. 11, 1980, the effectiveness of § 193.2119 was deferred, pending further notice.

DESIGN OF COMPONENTS AND BUILDINGS

§ 193.2121 General.

Components, including their foundations and support systems, must be designed, fabricated, and installed to withstand, without loss of functional or structural integrity, predictable loadings not including environmental design forces under Subpart B of this part unless applicable under that subpart.

§ 193.2123 Valves.

(a) Each valve, including control valves and relief valves, must be designed, manufactured, and tested to comply with ANSI B31.3 or ANSI B31.5 or ANSI B31.8 or API Standard 6D, if design conditions fall within their scope.

(b) Extended bonnet valves must be used for service temperatures below −45.6° C (−50° F).

(c) Valves used for cryogenic liquid service must be designed to operate in the position in which they are installed.

(d) Powered local and remote operation must be provided for valves intended for use during a controllable emergency that would be difficult or excessively time-consuming to operate manually during such an emergency.

(e) Valves must be designed and installed so that an excessive load on the piping system does not render the valve inoperable.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-1, 45 FR 57419, Aug. 28, 1980]

§ 193.2125 Automatic shutoff valves.

Each automatic shutoff valve or combination of valves must—

(a) Have a fail-safe design;

(b) Operate to stop fluid flow which would endanger the operational integrity of plant equipment; and

(c) Close at a rate to avoid fluid hammer which would endanger the operating integrity of a component.

§ 193.2127 Piping.

(a) Piping must be designed, manufactured, and tested to comply with ANSI B 31.3.

(b) All cryogenic and hazardous fluid piping must have connections to facilitate blowdown and purge as required by this part.

(c) Each cryogenic or hazardous fluid piping system that is aboveground must be identified by color coding, painting, or labeling.

(d) Seamless pipe or pipe with a longitudinal joint efficienty of 1.0 determined in accordance with ANSI B31.3, or pipe with a design pressure less than two-thirds of the mill-proof test pressure or subsequent shop or field hydrostatic test pressure must be used for process and transfer piping handling cryogenic or other hazardous fluids with a service temperature below −22° F (−30° C).

(e) For longitudinal or spiral weld piping handling LNG or cryogenic fluids, the heat affected zone must comply with section 323.2.2 of ANSI B31.3.

(f) Threaded piping used in hazardous fluid service must be at least Schedule 80.

§ 193.2129 Piping attachments and supports.

Piping attachments and supports for LNG or refrigerant piping must be designed to prevent excessive heat transfer which can result in either unintentional restraint of piping caused by ice formations or the embrittlement of supporting steel.

§ 193.2131 Building design.

(a) Each building or structural enclosure in which potentially hazardous quantities of flammable materials are handled must be designed and constructed to minimize fire hazards.

(b) Buildings or structural enclosures in which hazardous or cryogenic fluids are handled shall be of lightweight, noncombustible construction with nonload-bearings walls.

(c) If rooms containing such fluids are located within or attached to buildings in which such fluids are not handled, i.e., control rooms, shops, etc., the common walls shall be limited to not more than two in number, shall be designed to withstand a static pressure of at least 4800 Pa (100 psf), have no doors or other communicating openings, and shall have a fire resistance rating of at least 1 hour.

§ 193.2133 Buildings; ventilation.

(a) Each building in which potentially hazardous quantities of flammable fluids are handled must be ventilated to minimize the possibility, during normal operation, of hazardous accumulation of a flammable gas and air mixture, hazardous products of combustion, and other hazardous vapors in enclosed process areas by one of the following means:

(1) A continuously operating mechanical ventilation system;

(2) A combination gravity ventilation system and normally off mechanical ventilation system which is activated by suitable flammable gas detectors at a concentration not exceeding 25 percent of the lower flammable limit of the gas;

(3) A dual rate mechanical ventilation system with the high rate activated by suitable flammable gas detectors at a concentration not exceeding 25 percent of the lower flammable limit of the gas; or

(4) A gravity ventilation system composed of a combination of wall openings, roof ventilators, and, if there are basements or depressed floor levels, a supplemental mechanical ventilation system.

(b) The ventilation rate must be at least 1 cubic foot per minute of air per square foot of floor area. If vapors heavier than air can be present, the ventilation must be proportioned according to the area of each level.

§ 193.2135 Expansion or contraction.

Each operator shall consider the amount of contraction and expansion of each component during operating and environmental thermal cycling and shall—

(a) Provide components that operate without detrimental stress or restriction of movement, within each component and between components, caused by contraction and expansion; and

(b) Prevent ice buildup from detrimentally restricting the movement of components caused by contraction and expansion.

§ 193.2137 Frost heave.

(a) Each operator shall—

(1) Determine which components and their foundations could be endangered by frost heave from ambient temperatures or operating temperatures of the component; and

(2) Provide protection against frost heave which might impair their structural integrity.

(b) For each component and foundation determined under paragraph (a) of this section, instrumentation must be installed to warn of potential structural impairment due to frost heave, unless the operator includes in the maintenance procedures required by this part, a method and schedule of inspection that will detect changes in the elevation.

§ 193.2139 Ice and snow.

(a) Components must be designed to support the weight of ice and snow which could normally collect or form on them.

(b) Each operator shall provide protection for components from falling ice or snow which may accumulate on structures.

(c) Valves and moving components must not become inoperative due to ice formation on the component.

§ 193.2141 Electrical systems.

(a) Each operator shall select and install electrical equipment and wiring for components in accordance with NFPA-70 and, where applicable section 7-62 of NFPA-59A.

(b) Electrical grounding and bonding must be in accordance with section 7-7.1.1 of NFPA-59A.

(c) Protective measures for stray or impressed currents must be provided in accordance with section 7-7.3 of NFPA-59A.

§ 193.2143 Lightning.

Each operator shall install proper grounds as necessary to minimize the hazard to plant personnel and components, including all electrical circuits, as a result of lightning.

§ 193.2145 Boilers and pressure vessels.

Boilers must be designed and fabricated in accordance with section I or section IV of the ASME Boiler and Pressure Vessel Code. Other pressure vessels subject to that Code must be designed and fabricated in accordance with Division 1 or Division 2 of section VIII.

§ 193.2147 Combustion engines and turbines.

Combustion engines and gas turbines must be installed in accordance with NFPA-37.

IMPOUNDMENT DESIGN AND CAPACITY

§ 193.2149 Impoundment required.

(a) An impounding system must be provided for storage tanks to contain a potential spill of LNG or other hazardous liquid.

(b) Grading or drainage or an impounding system must be provided to ensure that accidental spills or leaks from the following components and areas do not endanger components or adjoining property or enter navigable waterways:

(1) Liquefaction and other process equipment;

(2) Vaporizers;

(3) Transfer systems;

(4) Parking areas for tank cars or tank trucks; and

(5) Areas for loading, unloading, or storing portable containers and dewar vessels.

(c) Impounding systems for LNG must be designed and constructed in accordance with this subpart. Impounding systems intended for containment of hazardous liquids other than LNG must meet the requirements of NFPA-30.

§ 193.2151 General design characteristics.

(a) An impounding system must have a configuration or design which, to the maximum extent possible, will prevent liquid from escaping impoundment by leakage, splash from collapse of a structure or part thereof, momentum and low surface friction, foaming, failure of pressurized piping, and accidental pumping.

(b) The basic form of an impounding system may be excavation, a natural geological formation, manufactured diking, such as berms or walls, or any combination thereof.

§ 193.2153 Classes of impounding systems.

(a) For the purpose of this part, impounding systems are classified as follows:

Class 1. A system which surrounds the component served with the inner surface of the dike constructed against or within 24 inches of the component served.

Class 2. A system which surrounds the component or area served with the dike located a distance away from the component or at the periphery of the area.

Class 3. A system which conducts a spill by dikes and floors to a remote impounding space which does not surround the component or area served.

(b) In the case of an impounding system consisting of a combination of classes, requirements of this part regarding a single class apply according to the percentage of impoundment provided by each class.

§ 193.2155 Structural requirements.

(a) Subject to paragraph (b) of this section, the structural parts of an impounding system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of the following:

(1) The imposed loading from—

(i) Full hydrostatic head of impounded LNG;

(ii) Hydrodynamic action, including the effect of any material injected into the system for spill control;

(iii) The impingement of the trajectory of an LNG jet discharged at any predictable angle; and

(iv) Anticipated hydraulic forces from a credible opening in the component or item served, assuming that the discharge pressure equals design pressure.

(2) The erosive action from a spill, including jetting of spilling LNG, and any other anticipated erosive action including surface water runoff, ice formation, dislodgement of ice formation, and snow removal.

(3) The effect of the temperature, any thermal gradient, and any other anticipated degradation resulting from sudden or localized contact with LNG.

(4) Exposure to fire from impounded LNG or from sources other than impounded LNG.

(5) If applicable, the potential impact and loading on the dike due to—

(i) Collapse of the component or item served or adjacent components; and

(ii) If the LNG facility adjoins the right-of-way of any highway or railroad, collision by or explosion of a train, tank car, or tank truck that could reasonably be expected to cause the most severe loading.

(b) For spills from LNG storage tanks with Class 2 or 3 impounding systems, imposed loading and surging flow characteristics must be based on a credible release of the tank contents.

(c) If an LNG storage tank is located within a horizontal distance of 6,100 m. (20,000 ft.) from the nearest point of the nearest runway serving large aircraft as defined in 14 CFR Part 1.1, a Class 1 impounding system must be used which is designed to withstand collision by, or explosion of, the heaviest aircraft which can take off or land at the airport.

§ 193.2157 Coatings and coverings.

Insulation, sealants, or other coatings and coverings which are part of an impounding system—

(a) Must be noncombustible in an installed condition when exposed to an LNG fire resulting from a spill that covers the floor of the impounding space;

(b) Must withstand exposure to fire from sources determined as required by this part, other than impounded LNG, for a period of time until fire protective or fire extinguishing action is taken; and

(c) When used for the purpose of maintaining the functional integrity of an impounding system, must be capable of withstanding sudden exposure to LNG without loss of such integrity.

§ 193.2159 Floors.

Floors of Class 2 and Class 3 impounding systems must, to the extent feasible—

(a) Slope away from the component or item impounded and to a sump basin installed under § 193.2171;

(b) Slope away from the nearest adjacent component;

(c) Drain surface waters from the floor at rates based on a storm of 10-year frequency and 1-hour duration and other natural water sources; and

(d) Be designed to minimize the wetted floor area.

§ 193.2161 Dikes, general.

(a) Penetrations in dikes to accommodate piping or any other purpose are prohibited.

(b) An outer wall of a component served by an impounding system may not be used as a dike except for a concrete wall designed to comply with the requirements of § 193.2155(c) or equivalent design impact loading.

§ 193.2163 Vapor barriers.

If vapor barriers are installed in meeting the requirements of § 193.2059, they must be designed and constructed to detain LNG vapor.

§ 193.2165 Dike dimensions.

In addition to dike dimensions needed to comply with other requirements of this subpart, to minimize the possibility that a trajectory of accidentally discharged liquid would pass over the top of a dike, the horizontal distance from the inner wall of the component or vessel served to the closest inside edge of the top of the dike must at least equal the vertical distance from the maximum liquid level in the component or vessel to the inside edge of the top of the dike.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-1, 45 FR 57419, Aug. 28, 1980]

§ 193.2167 Covered systems.

(a) A covered impounding system is prohibited unless it is—

(1) Sealed from the atmosphere and filled with an inert gas; or

(2) Permanently interconnected with the vapor space of the component served.

(b) Flammable nonmetallic membranous covering is prohibited in a covered system.

(c) For systems to which paragraph (a)(1) of this section applies, instrumentation and controls must be provided to—

(1) Maintain pressures at a safe level; and

(2) Monitor gas concentrations in accordance with § 193.2169.

(d) Dikes must have adequate structural strength to assure that they can withstand impact from a collapsed cover and all anticipated conditions which could cause a failure of the impounding space cover.

§ 193.2169 Gas leak detection.

Appropriate areas within an impounding system where collection or passage of LNG or LNG vapor could be expected must be equipped with sensing and warning devices to monitor continuously for the presence of LNG or LNG vapor and to warn before LNG gas concentration levels exceed 25 percent of the lower flammable limit.

§ 193.2171 Sump basins.

Except for Class 1 impounding systems, a sump basin must be located in each impounding system for collection of water.

§ 193.2173 Water removal.

(a) Except for Class 1 systems, impounding systems must have sump pumps and piping running over the dike to remove water collecting in the sump basin.

(b) The water removal system must have adequate capacity to remove water at rates which equal the maximum predictable collection rate from a storm of 10-year frequency and 1-hour duration, and other natural causes.

(c) Sump pumps for water removal must—

(1) Be operated as necessary to keep the impounding space as dry as practical; and

(2) If sump pumps are designed for automatic operation, have redundant automatic shutdown controls to prevent operation when LNG is present.

§ 193.2175 Shared impoundment.

When an impounding system serves more than one LNG storage tank, a means must be provided to prevent low temperature or fire resulting from leakage from any one of the storage tanks served causing any other storage tank to leak. The means must not result in a vapor dispersion distance which exceeds the exclusion zone required by § 193.2059.

(49 U.S.C. 1674a; 49 CFR 1.53 and Appendix A of Part 1)

[Amdt. 193-1, 45 FR 57419, Aug. 28, 1980]

§ 193.2179 Impoundment capacity; general.

In addition to capacities otherwise required by this subpart, an impounding system must have sufficient volumetric capacity to provide for—

(a) Displacement by the component, tank car, tank truck, container, or dewar vessel served; and

(b) Where applicable, displacement which could occur when a higher density substance than the liquid to be impounded enters the system, considering all relevant means of assuring capacity.

§ 193.2181 Impoundment capacity, LNG storage tanks.

(a) Except as provided in paragraph (b) of this section, each impounding system serving an LNG storage tank must have a minimum volumetric liquid impoundment capacity as follows:

Number of tanks in system	Class or type of system	System capacity in percent of LNG tank's maximum liquid capacity
1	Class 1	110 percent.
	Classes 2 and 3	150 percent.
More than 1	Classes 2 and 3	100 percent of all tanks or 150 percent of largest tank, whichever is greater.

(b) For purposes of this section, a covered impounding system serving a single LNG storage tank may have a capacity of 110 percent of the LNG tank's maximum liquid capacity if it is covered by a roof that is separate and independent from the LNG storage tank.

§ 193.2183 Impoundment capacity; equipment and transfer systems.

If an impounding system serves a component under § 193.2149(b) (1)-(3), it must have a minimum volumetric liquid impoundment capacity equal to the sum of—

(a) One-hundred percent of the volume of liquid that could be contained in the component and, where applicable, tank car or tank truck served; and

(b) The maximum volume of liquid which could discharge into the impounding space from any single failure of equipment or piping during the time period necessary for spill detection, instrument response, and sequenced shutdown by the automatic shutdown system under § 193.2439.

§ 193.2185 Impoundment capacity; parking areas, portable containers.

Each impounding system serving an area listed under § 193.2149(b) (4) or (5) must have a minimum volumetric liquid impoundment capacity which complies with the requirements of § 193.2181, assuming each tank car, tank truck, portable container, or dewar vessel to be a storage tank.

LNG Storage Tanks

§ 193.2187 General.

(a) LNG storage tanks must comply with the requirements of this subpart and the other applicable requirements of this part.

(b) A flammable nonmetallic membrane liner may not be used as an inner container in a storage tank.

§ 193.2189 Loading forces.

Each part of an LNG storage tank must be designed to withstand without loss of functional or structural integrity any predictable combination of forces which would result in the highest stress to the part, including the following:

(a) Internal design pressure determined under § 193.2197.

(b) External design pressure determined under § 193.2199.

(c) Weight of the structure.

(d) Weight of liquid to be stored, except that in no case will the density assumed be less than 29.3 pounds per cubic foot (470 kilograms per cubic meter).

(e) Loads due to testing required by § 193.2327.

(f) Nonuniform reaction forces on the foundation due to predictable settling and other movement.

(g) Superimposed forces from piping, stairways, and other connected appurtenances.

(h) Predictable snow and ice loads.

(i) The loading of internal insulation on the inner container and outer shell due to compaction and movement of the container and shell over the design life of the insulation.

(j) In the case of vacuum insulation, the forces due to the vacuum.

(k) In the case of a positive pressure purge, the forces due to the maximum positive pressure of the purge gas.

§ 193.2191 Stratification.

LNG storage tanks with a capacity of 5,000 barrels or more must be equipped with means to mitigate a potential for rollover and overpressure such as:

(a) Selective filling at the top and bottom of the tank;

(b) Circulating liquid from the bottom to the top of the same tank; or

(c) Transferring liquid selectively from the bottom of the tank to the bottom or top of any adjacent storage tank.

§ 193.2193 Movement and stress.

(a) Each operator shall determine for normal operations of each LNG storage tank—

(1) The amount and pattern of predictable movement of components, including transfer piping, and the foundation, which could result from thermal cycling, loading forces, and ambient air changes; and

(2) For a storage tank with an inner container, the predictable movement of the inner container and the outer shell in relation to each other.

(b) Storage tanks must be designed to provide adequate allowance for stress due to movement determined under paragraph (a) of this section, including provisions that—

(1) Backfill does not cause excessive stresses on the tank structure due to expansion of the storage tank during warmup;

(2) Insulation does not settle to a damaging degree or unsafe condition during thermal cycling; and

(3) Expansion bends and other expansion or contraction devices are adequate to prevent excessive stress on tank penetrations, especially during cooldown from ambient temperatures.

§ 193.2195 Penetrations.

(a) All penetrations in an LNG storage tank must be designed in accordance with API 620, including Appendix Q.

(b) The loadings on all penetrations must be determined by an analysis of all contributing forces, including those from tank thermal movements, connecting piping thermal movements, hydraulic forces, applicable wind and earthquake forces, and the forces resulting from settlement or movement of the tank foundation or pipe supports.

(c) All penetrations in an LNG storage tank below the design liquid level must be fitted with an internal shutoff valve which is designed and installed so that any failure of the nozzle penetrating the tank will be outside the tank.

(d) The requirements of paragraphs (a) and (c) of this section do not apply to shop fabricated tanks of 70,000 gallons or less capacity. All penetrations in such tanks must be designed and installed in accordance with the applicable provisions of section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.

§ 193.2197 Internal design pressure.

(a) Each operator shall establish the internal design pressure at the top of each LNG storage tank, including a suitable margin above the maximum allowable working pressure.

(b) The internal design pressure of a storage tank may not be lower than the highest pressure in the vapor space resulting from each of the following events or combination thereof that predictably might occur, giving consideration to vapor handling equipment, relief devices in accordance with

§ 193.2429, and any other mitigating measures:

(1) Filling the tank with LNG including effects of increased vaporization rate due to superheat and sensible heat of the added liquid;

(2) Rollover;

(3) Fall in barometric pressure, using the worst combination of amount of fall and rate of fall which might predictably occur;

(4) Loss of effective insulation that may result from an adjacent fire, leak of liquid into the intertank space, or other predictable accident; and

(5) Flash vaporization resulting from pump recirculation.

§ 193.2199 External design pressure.

(a) Each operator shall establish the external design pressure at the top of each LNG storage tank, including a suitable margin below the minimum allowable working pressure.

(b) The external design pressure may not be higher than the lowest vapor pressure in the vapor space resulting from each of the following events or combinations thereof that predictably might occur, giving consideration to gas makeup systems, vacuum relief devices in accordance with § 193.2429, and any other mitigating measures.

(1) Withdrawing liquid from the tank;

(2) Withdrawing gas from the tank;

(3) Adding subcooled LNG to the tank; and

(4) Rise in barometric pressure, based on the worst combination of amount of rise and rate of rise which predictably might occur.

§ 193.2201 Internal temperature.

The liquid container of each LNG storage tank and all tank parts used in contact with LNG or its cold vapor shall be designed for the lowest bulk liquid temperature which can be attained in the LNG storage tank.

§ 193.2203 Foundation.

(a) Each LNG storage tank must have a stable foundation designed in accordance with generally accepted structural engineering practices.

(b) Each foundation must support design loading forces without detrimental settling that could impair the structural integrity of the tank.

§ 193.2205 Frost heave.

If the protection provided for LNG storage tank foundations from frost heave under § 193.2137(a) includes heating the foundation area—

(a) An instrumentation and alarm system must be provided to warn of malfunction of the heating system; and

(b) A means to correct the malfunction must be provided.

§ 193.2207 Insulation.

(a) Insulation on the outside of the outer shell of an LNG storage tank may not be used to maintain stored LNG at an operating temperature during normal operation.

(b) Insulation between an inner container and the outer shell of an LNG storage tank must—

(1) Be compatible with the contained liquid and its vapor;

(2) In its installed condition, be noncombustible; and

(3) Not significantly lose insulating properties by melting, settling, or other means due to a fire resulting from a spill that covers the floor of the impounding space around the tank.

§ 193.2209 Instrumentation for LNG storage tanks.

(a) Each LNG storage tank having a capacity over 70,000 gallons must be equipped with a sufficient number of sensing devices and personnel warning devices, as prescribed, which operate continuously while the tank is in operation to assure that each of the following conditions is not a potential hazard to the structural integrity or safety of the tank:

Condition	Instrumentation
(1) Amount of liquid in the tank.	Redundant liquid level gages and recorders with high level alarms, and a minimum of one independent high level alarm.
(2) Vapor pressure within the tank.	Redundant gages and recorders with high and low pressure alarms.

Condition	Instrumentation
(3) Temperatures at representative critical points in the foundation.	Temperature indicating and recording devices with alarm.
(4) Temperature of contained liquid at various vertical intervals.	Temperature recorders.
(5) Abnormal temperature in tank structure.	Thermocouples located at representative critical points with recorders.
(6) Excessive relative movement of inner container and outer shell.	Linear and rotational movement indicators located between inner container and outer shell with recorders.

(b) LNG storage tanks with a capacity of 70,000 gallons or less must be equipped with the following:

(1) LNG liquid trycocks, when attended during the filling operation.

(2) Pressure gages and recorders with high pressure alarm.

(3) Differential pressure liquid level gage.

(c) Each storage tank must be designed as appropriate to provide for compliance with the inspection requirements of this part.

§ 193.2211 Metal storage tanks.

(a) Metal storage tanks with internal design pressures of not more than 15 psig must be designed and constructed in accordance with API Standard 620 and, where applicable, Appendix Q of that standard.

(b) Metal storage tanks with internal design pressures above 15 psig must be designed in accordance with the applicable division of section VIII of the ASME Boiler and Pressure Vessel Code.

§ 193.2213 Concrete storage tanks.

Concrete storage tanks must be designed and constructed in accordance with section 4-3 of NFPA-59A.

§ 193.2215 Thermal barriers.

Thermal barriers must be provided between piping and an outer shell when necessary to prevent the outer shell from being exposed during normal operation to temperatures lower than its design temperature.

§ 193.2217 Support system.

(a) Saddles and legs must be designed in accordance with generally accepted structural engineering practices, taking into account loads during transportation, erection loads, and thermal loads.

(b) Storage tank stress concentrations from support systems must be minimized by distribution of loads using pads, load rings, or other means.

(c) For a storage tank with an inner container, support systems must be designed to—

(1) Minimize thermal stresses imparted to the inner container and outer shell from expansion and contraction; and

(2) Sustain the maximum applicable loading from shipping and operating conditions.

(d) LNG storage tanks with an air space beneath the tank bottom or its foundation must be designed to withstand without loss of functional or structural integrity, the forces caused by the ignition of a combustible vapor cloud in this space.

§ 193.2219 Internal piping.

Piping connected to an inner container that is located in the space between the inner container and outer shell must be designed for not less than the pressure rating of the inner container. The piping must contain expansion loops where necessary to protect against thermal and other secondary stresses created by operation of the tank. Bellows may not be used within the space between the inner container and outer shell.

§ 193.2221 Marking.

(a) Each operator shall install and maintain a name plate in an accessible place on each storage tank and mark it in accordance with the applicable code or standard incorporated by reference in § 193.2211 or § 193.2213.

(b) Each penetration in a storage tank must be marked indicating the function of the penetration.

(c) Marking required by this section must not be obscured by frosting.

DESIGN OF TRANSFER SYSTEMS

§ 193.2223 General.

(a) Transfer systems must comply with the requirements of this subpart and other applicable requirements of this part.

(b) The design of transfer systems must provide for stress due to the frequency of thermal cycling and intermittent use to which the transfer system may be subjected.

(c) Slip type expansion joints are prohibited and packing-type joints may not be used in transfer systems for LNG or flammable refrigerants.

(d) A suitable means must be provided to precool the piping in a manner that prevents excessive stress prior to normal transfer of cold fluids.

(e) Stresses due to thermal and hydraulic shock in the piping system must be determined and accommodated by design to avoid damage to piping.

§ 193.2227 Backflow.

(a) Each transfer system must operate with a means to—

(1) Prevent backflow of liquid from a receiving container, tank car, or tank truck from causing a hazardous condition; and

(2) Maintain one-way flow where necessary for the integrity or safe operation of the LNG facility.

(b) The means provided under paragraph (a)(1) of this section must be located as close as practical to the point of connection of the transfer system and the receiving container, tank car, or tank truck.

§ 193.2229 Cargo transfer systems.

(a) Each cargo transfer system must have—

(1) A means of safely depressurizing and venting that system before disconnection;

(2) A means to provide for safe vapor displacement during transfer;

(3) Transfer piping, pumps, and compressors located or protected by suitable barriers so that they are safe from damage by tank car or tank truck movements;

(4) A signal light at each control location or remotely located pumps or compressors used for transfer which indicates whether the pump or compressor is off or in operation; and

(5) A means of communication between loading or unloading areas and other areas in which personnel are associated with the transfer operations.

(b) Hoses and arms for cargo transfer systems must be designed as follows—

(1) The design must accommodate operating pressures and temperatures encountered during the transfers;

(2) Hoses must have a bursting pressure of not less than five times the operating pressure.

(3) Arms must meet the requirements of ANSI B31.3.

(4) Adequate support must be provided, taking into account ice formation.

(5) Couplings must be designed for the frequency of any coupling or uncoupling.

§ 193.2231 Cargo transfer area.

The transfer area of a cargo transfer system must be designed—

(a) To accommodate tank cars and tank trucks without excessive maneuvering; and

(b) To permit tank trucks to enter or exit the transfer area without backing.

§ 193.2233 Shutoff valves.

(a) Shutoff valves on transfer systems must be located—

(1) On each liquid supply line, or common line to multiple supply lines, to a storage tank, or to a cargo transfer system;

(2) On each vapor or liquid return line from multiple return lines, used in a cargo transfer system;

(3) At the connection of a transfer system with a pipeline subject to Part 192 of this chapter; and

(4) To provide for proper operation and maintenance of each transfer system.

(b) Transfer system shutoff valves that are designated for operation in the emergency procedures must be manually operable at the valve and power operable at the valve and at a remote location at least 50 feet from the valve.

Subpart D—Construction

§ 193.2301 Scope.

This subpart prescribes requirements for the construction or installation of components.

§ 193.2303 Construction acceptance.

No person may place in service any component until it passes all applicable inspections and tests prescribed by this subpart.

§ 193.2304 Corrosion control overview.

(a) Subject to paragraph (b) of this section, components may not be constructed, repaired, replaced, or significantly altered until a person qualified under § 193.2707(c) reviews the applicable design drawings and materials specifications from a corrosion control viewpoint and determines that the materials involved will not impair the safety or reliability of the component or any associated components.

(b) The repair, replacement, or significant alteration of components must be reviewed only if the action to be taken—

(1) Involves a change in the original materials specified;

(2) Is due to a failure caused by corrosion; or

(3) Is occasioned by inspection revealing a significant deterioration of the component due to corrosion.

(49 U.S.C. 1674(a); 49 CFR 1.53 and Appendix A to Part 1)

[Amdt. 193-2, 45 FR 70404, Oct. 23, 1980]

§ 193.2305 Procedures.

(a) In performing construction, installation, inspection, or testing, an operator must follow written specifications, procedures, and drawings, as appropriate, that are consistent with this part, taking into account relevant mechanical, chemical, and thermal properties, component functions, and environmental effects that are involved.

(b) All procedures, including any field revisions, must be substantiated by testing or experience to produce a component that is reliable and complies with the design and installation requirements of this part.

§ 193.2307 Inspection.

(a) All construction, installation, and testing activities must be inspected as frequently as necessary in accordance with a written plan to assure that—

(1) Activities are in compliance with all applicable requirements of this subpart; and

(2) Components comply with the applicable material, design, fabrication, installation, and construction requirements of this part.

(b) In addition to the requirements of paragraph (a) of this section, the construction of concrete storage tanks must be inspected in accordance with ACI-311-75.

(c) Each operator shall have a quality assurance inspection program to verify that components comply with their design specifications and drawings, including any field design changes, before they are placed in service.

§ 193.2309 Inspection and testing methods

Except as otherwise provided by this subpart, each operator shall determine, commensurate with the hazard that would result from failure of the component concerned, the scope and nature of—

(a) Inspections and tests required by this subpart; and

(b) Inspection and testing procedures required by § 193.2305.

§ 193.2311 Cleanup.

After construction or installation, as the case may be, all components must be cleaned to remove all detrimental contaminants which could cause a hazard during operation, including the following:

(a) All flux residues used in brazing or soldering must be removed from the joints and the base metal to prevent corrosive solutions from being formed.

(b) All solvent type cleaners must be tested to ensure that they will not damage equipment integrity or reliability.

(c) Incompatible chemicals must be removed.

(d) All contaminants must be captured and disposed of in a manner that does not reduce the effectiveness of corrosion protection and monitoring provided as required by this part.

§ 193.2313 Pipe welding.

(a) Each operator shall provide the following for welding on pressurized piping for LNG and other hazardous fluids:

(1) Welding procedures and welders qualified in accordance with section IX of the ASME Boiler and Pressure Vessel Code or API 1104, as applicable;

(2) When welding materials that are qualified by impact testing, welding procedures selected to minimize degradation of low temperature properties of the pipe material; and

(3) When welding attachments to pipe, procedures and techniques selected to minimize the danger of burnthroughs and stress intensification.

(b) Oxygen fuel gas welding is not permitted on flammable fluid piping with a service temperature below −20°C (−22°F).

(c) Marking materials for identifying welds on pipe must be compatible with the basic pipe material.

(d) Surfaces of components that are less than 6.35 mm (0.25 in.) thick may not be field die stamped.

(e) Where die stamping is permitted, any identification marks must be made with a die having blunt edges to minimize stress concentration.

§ 193.2315 Piping connections.

(a) Piping more than 2 inches nominal diameter must be joined by welding, except that—

(1) Threaded or flanged connections may be used where necessary for special connections, including connections for material transitions, instrument connections, testing, and maintenance;

(2) Copper piping in nonflammable service may be joined by silver brazing; and

(3) Material transitions may be made by any joining technique proven reliable under § 193.2305(b).

(b) If socket fittings are used, a clearance of 1.6 to 3.2 mm (0.063 to 0.126 in.) between the pipe end and the bottom of the socket recess must be provided and appropriate measurement reference marks made on the piping for the purpose of inspection.

(c) Threaded joints must be—

(1) Free of stress from external loading; and

(2) Seal welded, or sealed by other means which have been tested and proven reliable.

(d) Compression type couplings must meet the requirements of ANSI B31.3.

(e) Care shall be taken to ensure the tightness of all bolted connections. Spring washers or other such devices designed to compensate for the contraction and expansion of bolted connections during operating cycles shall be used where required.

(f) The selection of gasket material shall include the consideration of fire.

§ 193.2317 Retesting.

After testing required by this subpart is completed on a component to contain a hazardous fluid, the component must be retested whenever—

(a) Penetration welding other than tie-in welding is performed; or

(b) The structural integrity of the component is disturbed.

§ 193.2319 Strength tests.

(a) A strength test must be performed on each piping system and container to determine whether the component is capable of performing its design function, taking into account—

(1) The maximum allowable working pressure;

(2) The maximum weight of product which the component may contain or support;

(b) For piping, the test required by paragraph (a) of this section must include a pressure test conducted in accordance with section 337 of ANSI B31.3, except that test pressures must be based on the design pressure. Carbon and low alloy steel piping must be pressure tested above their nil ductility transition temperature.

(c) All shells and internal parts of heat exchangers to which section VIII, Division 1, or Division 2 of the ASME Boiler and Pressure Vessel Code, applies must be pressure tested, inspected, and stamped in accordance therewith.

§ 193.2321 Nondestructive tests.

(a) The following percentages of each day's circumferentially welded pipe joints for hazardous fluid piping, selected at random, must be nondestructively tested over the entire circumference to indicate any defects which could adversely affect the integrity of the weld or pipe:

Weld type	Cryogenic piping	Other	Test method
Butt weld more than 2 inches in nominal size.	100	30	Radiographic or ultrasonic.
Butt welds 2 inches or less in nominal size.	100	30	Radiographic, ultrasonic, liquid penetrant, or magnetic particle.
Fillet and socket welds.	100	30	Liquid penetrant or magnetic particle.

(b) Evaluation of weld tests and repair of defects must be in accordance with the requirements of ANSI B31.3 or API 1104, as applicable.

(c) Where longitudinally or spiral welded pipe is used in transfer systems, 100 percent of the seam weld must be examined by radiographic or ultrasonic inspection.

(d) The butt welds in metal shells of storage tanks with internal design pressure of not more than 15 psig must be radiographically tested in accordance with section 0.7.6, API 620, Appendix Q, except that for hydraulic load bearing shells with curved surfaces that are subject to cryogenic temperatures, 100 percent of both longitudinal (or meridional) and circumferential or (or latitudinal) welds must be radiographically tested.

(e) The butt welds in metal shells of storage tanks with internal design pressure above 15 psig must be radiographically tested in accordance with section IX of the ASME Boiler and Pressure Vessel Code, except that for hydraulic load bearing shells with curved surfaces that are subject to cryogenic temperatures, 100 percent of both longitudinal (or meridional) and circumferential (or latitudinal) welds must be radiographically tested.

§ 193.2323 Leak tests.

(a) Each container and piping system must be initially tested to assure that the component will contain the product for which it is designed without leakage.

(b) Shop fabricated containers and all flammable fluid piping must be leak tested to a minimum of the design pressure after installation but before placing it in service.

(c) For a storage tank with vacuum insulation, the inner container, outer shell, and all internal piping must be tested for vacuum leaks in accordance with an appropriate procedure.

§ 193.2325 Testing control systems.

Each control system must be tested before being placed in service to assure that it has been installed properly and will function as required by this part.

§ 193.2327 Storage tank tests.

(a) In addition to other applicable requirements of this subpart, storage tanks for cryogenic fluids with internal design pressures of not more than 15 psig must be tested in accordance with sections Q8 and Q9 of API 620, Appendix Q, as applicable.

(b) Metal storage tanks for cryogenic fluids with internal design pressures above 15 psig must be tested in accordance with the applicable division of section VIII of the ASME Boiler and Pressure Vessel Code.

(c) Reference measurements must be made with appropriate precise instruments to assure that the tank is gas tight and lateral and vertical movement of the storage tank does not exceed predetermined design tolerances.

§ 193.2329 Construction records.

For the service life of the component concerned, each operator shall retain appropriate records of the following:

(a) Specifications, procedures, and drawings prepared for compliance with § 193.2305; and

(b) Results of tests, inspections, and the quality assurance program required by this subpart.

EFFECTIVE DATE NOTE: At 45 FR 9184-9185, Feb. 11, 1980, the effectiveness of § 193.2329 was deferred pending further notice.

Subpart E—Equipment

§ 193.2401 Scope.

This subpart prescribes requirements for the design, fabrication, and installation of vaporization equipment, liquefaction equipment, and control systems.

VAPORIZATION EQUIPMENT

§ 193.2403 General.

Vaporizers must comply with the requirements of this subpart and the other applicable requirements of this part.

§ 193.2405 Vaporizer design.

(a) Vaporizers must be designed and fabricated in accordance with applicable provisions of section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.

(b) Each vaporizer must be designed for the maximum allowable working pressure at least equal to the maximum discharge pressure of the pump or pressurized container system supplying it, whichever is greater.

§ 193.2407 Operational control.

(a) Vaporizers must be equipped with devices which monitor the inlet pressure of the LNG, the outlet temperature, and the pressure of the vaporized gas, and the inlet pressure of the heating medium fluids.

(b) Manifolded vaporizers must be equipped with:

(1) Two inlet valves in series to prevent LNG from entering an idle vaporizer; and

(2) A means to remove LNG or gas which accumulates between the valves.

§ 193.2409 Shutoff valves.

(a) A shutoff valve must be located on transfer piping supplying LNG to a vaporizer. The shutoff valve must be located at a sufficient distance from the vaporizer to minimize potential for damage from explosion or fire at the vaporizer. If the vaporizer is installed in a building, the shutoff valve must be located outside the building.

(b) A shutoff valve must be located on each outlet of a vaporizer.

(c) For vaporizers designed to use a flammable intermediate fluid, a shutoff valve must be located on the inlet and outlet line of the intermediate fluid piping system where they will be operable during a controllable emergency involving the vaporizer.

§ 193.2411 Relief devices.

The capacity of pressure relief devices required for vaporizers by § 193.2429 is governed by the following:

(a) For heated vaporizers, the capacity must be at least 110 percent of rated natural gas flow capacity without allowing the pressure to rise more than 10 percent above the vaporizer's maximum allowable working pressure.

(b) For ambient vaporizers, the capacity must be at least 150 percent of rated natural gas flow capacity without allowing the pressure to rise more than 10 percent above the vaporizer's maximum allowable working pressure.

§ 193.2413 Combustion air intakes.

(a) Combustion air intakes to vaporizers must be equipped with sensing devices to detect the induction of a flammable vapor.

(b) If a heated vaporizer or vaporizer heater is located in a building, the combustion air intake must be located outside the building.

LIQUEFACTION EQUIPMENT

§ 193.2415 General.

Liquefaction equipment must comply with the requirements of this subpart and the other applicable requirements of this part.

§ 193.2417 Control of incoming gas.

A shutoff valve must be located on piping delivering natural gas to each liquefaction system.

§ 193.2419 Backflow.

Each multiple parallel piping system connected to liquefaction equipment must have devices to prevent backflow from causing a hazardous condition.

§ 193.2421 Cold boxes.

(a) Each cold box in a liquefaction system must be equipped with a means of monitoring or detecting, as appropriate, the concentration of natural gas in the insulation space.

(b) If the insulation space in a cold box is designed to operate with a gas rich atmosphere, additional natural gas must be introduced when the concentration of gas falls to 30 percent.

(c) If the insulation space of a cold box is designed to operate with a gas free atmosphere, additional air or inert gas, as appropriate, must be introduced when the concentration of gas is 25 percent of the lower flammable limit.

§ 193.2423 Air in gas.

Where incoming gas to liquefaction equipment contains air, each operator shall provide a means of preventing a flammable mixture from occurring under any operating condition.

CONTROL SYSTEMS

§ 193.2427 General.

(a) Control systems must comply with the requirements of this subpart and other applicable requirements of this part.

(b) Each control system must be capable of performing its design function under normal operating conditions.

(c) Control systems must be designed and installed in a manner to permit maintenance, including inspection or testing, in accordance with this part.

(d) Local, remote, and redundant signal lines installed for control systems that can affect the operation of a component that does not fail safe must be routed separately or in separate underground conduits installed in accordance with NFPA-70.

§ 193.2429 Relief devices.

(a) Each component containing a hazardous fluid must be equipped with a system of automatic relief devices which will release the contained fluid at a rate sufficient to prevent pressures from exceeding 110 percent of the maximum allowable working pressure. In establishing relief capacity, each operator shall consider trapping of fluid between valves; the maximum rates of boiloff and expansion of fluid which may occur during normal operation, particularly cooldown; and controllable emergencies.

(b) A component in which internal vacuum conditions can occur must be equipped with a system of relief devices or other control system to prevent development in the component of a vacuum that might create a hazardous condition. Introduction of gas into a component must not create a flammable mixture within the component.

(c) In addition to the control system required by paragraphs (a) and (b) of this section—

(1) Each LNG Storage tank must be equipped with relief devices to assure that design pressure and vacuum relief capacity is available during maintenance of the system; and

(2) A manual means must be provided to relieve pressure and vacuum in an emergency.

(d) Relief devices must be installed in a manner to minimize the possibility that release of fluid could—

(1) Cause an emergency; or

(2) Worsen a controllable emergency.

(e) The means for adjusting the set-point pressure of all adjustable relief devices must be sealed.

(f) Relief devices which are installed to limit minimum or maximum pressure may not be used to handle boiloff and flash gases during normal operation.

§ 193.2431 Vents.

(a) Hazardous fluids may not be relieved into the atmosphere of a building or other confined space.

(b) Boiloff vents for hazardous fluids may not draw in air during operation.

(c) Venting of natural gas/vapor under operational control which could produce a hazardous gas atmosphere must be directed to a flare stack or heat exchanger in order to raise its temperature to achieve positive buoyancy and safe venting.

(49 U.S.C. 1674(a); 49 CFR 1.53 and Appendix A to Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-2, 45 FR 70404, Oct. 23, 1980]

§ 193.2433 Sensing devices.

(a) Each operator shall determine the appropriate location for and install sensing devices as necessary to—

(1) Monitor the operation of components to detect a malfunction which could cause a hazardous condition if permitted to continue; and

(2) Detect the presence of fire or combustible gas in areas determined in accordance with section 500-4 of NFPA 70 to have a potential for the presence of flammable fluids.

(b) Buildings in which potentially hazardous quantities of flammable fluids are used or handled must be continuously monitored by gas sensing devices set to activate audible and visual alarms in the building and at the control center when the concentration of the fluid in air is not more than 25 percent of the lower flammable limit.

§ 193.2435 Warning devices.

Each operator shall install warning devices in the control center to warn of hazardous conditions detected by all sensing devices required by this part. Warnings must be given both audibly and visibly and must be designed to gain the attention of personnel. Warnings must indicate the location and nature of the existing or potential hazard.

§ 193.2437 Pump and compressor control.

(a) Each pump and compressor for hazardous fluids must be equipped with—

(1) A control system, operable locally and remotely, to shut down the pump or compressor in a controllable emergency;

(2) A signal light at the pump or compressor and the remote control location which indicates whether the pump or compressor is in operation or off;

(3) Adequate valving to ensure that the pump or compressor can be isolated for maintenance; and

(4) A check valve on each discharge line where pumps or compressors operate in parallel.

(b) Pumps or compressors in a cargo transfer system must have shutdown controls at the loading or unloading area and at the pump or compressor site.

§ 193.2439 Emergency shutdown control systems.

(a) Each transfer system, vaporizer, liquefaction system, and storage system tank must be equipped with an emergency shutdown control system. The control must automatically actuate the shutdown of the component (providing pressure relief as necessary) when any of the following occurs:

(1) Temperatures of the component exceed the limits determined under § 193.2105;

(2) Pressure outside the limits of the maximum and minimum design pressure;

(3) Liquid in receiving vessel reaches the design maximum liquid level;

(4) Gas concentrations in the area of the component exceed 40 percent of the lower flammable limit;

(5) A sudden excessive pressure change or other condition indicating a potentially dangerous condition; and

(6) Presence of fire in area of component.

(b) For cargo transfer systems where all transfer operations are continuously manned and visually supervised by qualified personnel, actuation of the emergency shutdown control system may be manual after devices warn of the events listed in paragraph (a) of this section.

(c) Except for components that operate unattended and are remote from the control center, a reasonable delay may be programmed in emergency shutdown control systems required by this section between warning and automated shutdown to provide for manual response.

(d) Each LNG plant must have a shutdown control system to shut down all operations of the plant safely. The system must be operable at—

(1) The control center; and

(2) In the case of a plant where LNG facilities other than the control center are designed to operate unattended at the site of these facilities.

§ 193.2441 Control center.

Each LNG plant must have a control center from which operations and warning devices are monitored as required by this part. A control center must have the following capabilities and characteristics—

(a) It must be located apart or protected from other LNG facilities so that it is operational during a controllable emergency.

(b) Each remotely actuated control system and each automatic shutdown control system required by this part must be operable from the control center.

(c) Each control center must have personnel in continuous attendance while any of the components under its control are in operation, unless the control is being performed from another control center which has personnel in continuous attendance.

(d) If more than one control center is located at an LNG Plant, each control center must have more than one means of communication with each other center.

(e) Each control center must have a means of communicating a warning of hazardous conditions to other locations within the plant frequented by personnel.

§ 193.2443 Fail-safe control.

Control systems for components must have a fail-safe design. A safe condition must be maintained until personnel take appropriate action either to reactivate the component served or to prevent a hazard from occurring.

§ 193.2445 Sources of power.

(a) Electrical control systems, means of communication, emergency lighting, and firefighting systems must have at least two sources of power which function so that failure of one source does not affect the capability of the other source.

(b) Where auxiliary generators are used as a second source of electrical power—

(1) They must be located apart or protected from components so that they are not unusable during a controllable emergency; and

(2) Fuel supply must be protected from hazards.

Subpart F—Operations

Authority: 49 U.S.C. 1674(a); 49 CFR 1.53 and Appendix A to Part 1.

Source: Amdt. 193-2, 45 FR 70405, Oct. 23, 1980, unless otherwise noted.

§ 193.2501 Scope.

This subpart prescribes requirements for the operation of LNG facilities.

§ 193.2503 Operating procedures.

Each operator shall follow one or more manuals of written procedures to provide safety in normal operation and in responding to an abnormal operation that would affect safety. The procedures must include provisions for—

(a) Monitoring components or buildings according to the requirements of § 193.2507.

(b) Startup and shutdown, including for initial startup, performance testing to demonstrate that components will operate satisfactory in service.

(c) Recognizing abnormal operating conditions.

(d) Purging and inerting components according to the requirements of § 193.2517.

(e) In the case of vaporization, maintaining the vaporization rate, temperature and pressure so that the resultant gas is within limits established for the vaporizer and the downstream piping;

(f) In the case of liquefaction, maintaining temperatures, pressures, pressured differentials and flow rates, as applicable, within their design limits for:

(1) Boilers;

(2) Turbines and other prime movers;

(3) Pumps, compressors, and expanders;

(4) Purification and regeneration equipment; and

(5) Equipment within cold boxes.

(g) Cooldown of components according to the requirements of § 193.2505; and

(h) Compliance with § 193.2805(b).

§ 193.2505 Cooldown.

(a) The cooldown of each system of components that is subjected to cryogenic temperatures must be limited to a rate and distribution pattern that keeps thermal stresses within design limits during the cooldown period, paying particular attention to the performance of expansion and contraction devices.

(b) After cooldown stabilization is reached, cryogenic piping systems must be checked for leaks in areas of flanges, valves, and seals.

§ 193.2507 Monitoring operations.

Each component in operation or building determined under § 193.2805(a)(2) in which a hazard to persons or property could exist must be monitored to detect fire or any malfunction or flammable fluid which could cause a hazardous condition. Monitoring must be accomplished by watching or listening from an attended control center for warning alarms, such as gas, temperature, pressure, vacuum, and flow alarms, or by conducting an inspection or test at intervals specified in the operating procedures.

§ 193.2509 Emergency procedures.

(a) Each operator shall determine the types and places of emergencies other than fires that may reasonably be expected to occur at an LNG plant due to operating malfunctions, structural collapse, personnel error, forces of nature, and activities adjacent to the plant.

(b) To adequately handle each type of emergency identified under paragraph (a) of this section and each fire emergency identified under § 193.2817(a), each operator shall follow one or more manuals of written procedures. The procedures must provide for the following:

(1) Responding to controllable emergencies, including notifying personnel and using equipment appropriate for handling the emergency.

(2) Recognizing an uncontrollable emergency and taking action to minimize harm to the public and personnel, including prompt notification of appropriate local officials of the emergency and possible need for evacuation of the public in the vicinity of the LNG plant.

(3) Coordinating with appropriate local officials in preparation of an emergency evacuation plan, which sets forth the steps required to protect the public in the event of an emergency, including catastrophic failure of an LNG storage tank.

(4) Cooperating with appropriate local officials in evacuations and emergencies requiring mutual assistance and keeping these officials advised of—

(i) The LNG plant fire control equipment, its location, and quantity of units located throughout the plant;

(ii) Potential hazards at the plant, including fires;

(iii) Communication and emergency control capabilities at the LNG plant; and

(iv) The status of each emergency.

§ 193.2511 Personnel safety.

(a) Each operator shall provide any special protective clothing and equipment necessary for the safety of personnel while they are performing emergency response duties.

(b) All personnel who are normally on duty at a fixed location, such as a building or yard, where they could be harmed by thermal radiation from a burning pool of impounded liquid, must be provided a means of protection at that location from the harmful effects of thermal radiation or a means of escape.

(c) Each LNG plant must be equipped with suitable first-aid material, the location of which is clearly marked and readily available to personnel.

EFFECTIVE DATE NOTE: Section 193.2511 becomes effective Jan. 1, 1982. See Amdt. 193-2, 45 FR 70390, Oct. 23, 1980.

§ 193.2513 Transfer procedures.

(a) Each transfer of LNG or other hazardous fluid must be conducted in accordance with one or more manuals of written procedures to provide for safe transfers.

(b) The transfer procedures must include provisions for personnel to:

(1) Before transfer, verify that the transfer system is ready for use, with

connections and controls in proper positions, including if the system could contain a combustible mixture, verifying that it has been adequately purged in accordance with a procedure which meets the requirements of AGA "Purging Principles and Practice."

(2) Before transfer, verify that each receiving container or tank vehicle does not contain any substance that would be incompatible with the incoming fluid and that there is sufficient capacity available to receive the amount of fluid to be transferred;

(3) Before transfer, verify the maximum filling volume of each receiving container or tank vehicle to ensure that expansion of the incoming fluid due to warming will not result in overfilling or overpressure;

(4) When making bulk transfer of LNG into a partially filled (excluding cooldown heel) container, determine any differences in temperature or specific gravity between the LNG being transferred and the LNG already in the container and, if necessary, provide a means to prevent rollover due to stratification.

(5) Verify that the transfer operations are proceeding within design conditions and that overpressure or overfilling does not occur by monitoring applicable flow rates, liquid levels, and vapor returns.

(6) Manually terminate the flow before overfilling or overpressure occurs; and

(7) Deactivate cargo transfer systems in a safe manner by depressurizing, venting, and disconnecting lines and conducting any other appropriate operations.

(c) In addition to the requirements of paragraph (b) of this section, the procedures for cargo transfer must be located at the transfer area and include provisions for personnel to:

(1) Be in constant attendance during all cargo transfer operations;

(2) Prohibit the backing of tank trucks in the transfer area, except when a person is positioned at the rear of the truck giving instructions to the driver;

(3) Before transfer, verify that—

(i) Each tank car or tank truck complies with applicable regulations governing its use;

(ii) All transfer hoses have been visually inspected for damage and defects;

(iii) Each tank truck is properly immobilized with chock wheels, and electrically grounded; and

(iv) Each tank truck engine is shut off unless it is required for transfer operations;

(4) Prevent a tank truck engine that is off during transfer operations from being restarted until the transfer lines have been disconnected and any released vapors have dissipated;

(5) Prevent loading LNG into a tank car or tank truck that is not in exclusive LNG service or that does not contain a positive pressure if it is in exclusive LNG service, until after the oxygen content in the tank is tested and if it exceeds 2 percent by volume, purged in accordance with a procedure that meets the requirements of AGA "Purging Principles and Practice;"

(6) Verify that all transfer lines have been disconnected and equipment cleared before the tank car or tank truck is moved from the transfer position; and

(7) Verify that transfers into a pipeline system will not exceed the pressure or temperature limits of the system.

§ 193.2515 Investigations of failures.

(a) Each operator shall investigate the cause of each explosion, fire, or LNG spill or leak which results in—

(1) Death or injury requiring hospitalization; or

(2) Property damage exceeding $10,000.

(b) As a result of the investigation, appropriate action must be taken to minimize recurrence of the incident.

(c) If the Director or relevant state agency under section 5 of the Natural Gas Pipeline Safety Act of 1968 (49 U.S.C. 1674) investigates an incident, the operator involved shall make available all relevant information and provide reasonable assistance in conducting the investigation. Unless necessary to restore or maintain service, or for safety, no component involved in the incident may be moved from its location or otherwise altered until the investigation is complete or the investigating agency otherwise provides. Where components must be moved for operational or safety reasons, they must not be removed from the plant site and must be maintained intact to the extent practicable until the investigation is complete or the investigating agency otherwise provides.

§ 193.2517 Purging.

When necessary for safety, components that could accumulate significant amounts of combustible mixtures must be purged in accordance with a procedure which meets the provisions of the AGA "Purging Principles and Practice" after being taken out of service and before being returned to service.

§ 193.2519 Communication systems.

(a) Each LNG plant must have a primary communication system that provides for verbal communications between all operating personnel at their work stations in the LNG plant.

(b) Each LNG plant in excess of 70,000 gallons storage capacity must have an emergency communication system that provides for verbal communications between all persons and locations necessary for the orderly shutdown of operating equipment and the operation of safety equipment in time of emergency. The emergency communication system must be independent of and physically separated from the primary communication system and the security communication system under § 193.2909.

(c) Each communication system required by this part must have an auxiliary source of power, except sound-powered equipment.

EFFECTIVE DATE NOTE: Section 193.2519 becomes effective Jan. 1, 1982. See Amdt. 193-2, 45 FR 70390, Oct. 23, 1980.

§ 193.2521 Operating records.

Each operator shall maintain a record of the results of each inspection, test, and investigation required by this subpart. Such records must be kept for a period of not less than 5 years.

Subpart G—Maintenance

AUTHORITY: 49 U.S.C. 1674(a); 49 CFR 1.53 and Appendix A to Part 1.

SOURCE: Amdt. 193-2, 45 FR 70407, Oct. 23, 1980, unless otherwise noted.

§ 193.2601 Scope.

This subpart prescribes requirements for maintaining components at LNG plants.

§ 193.2603 General.

(a) Each component in service, including its support system, must be maintained in a condition that is compatible with its operational or safety purpose by repair, replacement, or other means.

(b) An operator may not place, return, or continue in service any component which is not maintained in accordance with this subpart.

(c) Each component taken out of service must be identified in the records kept under § 193.2639.

(d) If a safety device is taken out of service for maintenance, the component being served by the device must be taken out of service unless the same safety function is provided by an alternate means.

(e) If the inadvertent operation of a component taken out of service could cause a hazardous condition, that component must have a tag attached to the controls bearing the words "do not operate" or words of comparable meaning.

§ 193.2605 Maintenance procedures.

(a) Each operator shall determine and perform, consistent with generally accepted engineering practice, the periodic inspections or tests needed to meet the applicable requirements of this subpart and to verify that components meet the maintenance standards prescribed by this subpart.

(b) Each operator shall follow one or more manuals of written procedures for the maintenance of each component, including any required corrosion control. The procedures must include—

(1) The details of the inspections or tests determined under paragraph (a)

of this section and their frequency of performance; and

(2) A description of other actions necessary to maintain the LNG plant in accordance with the requirements of this subpart and § 193.2805.

§ 193.2607 Foreign material.

(a) The presence of foreign material, contaminants, or ice shall be avoided or controlled to maintain the operational safety of each component.

(b) LNG plant grounds must be free from rubbish, debris, and other material which present a fire hazard. Grass areas on the LNG plant grounds must be maintained in a manner that does not present a fire hazard.

§ 193.2609 Support systems.

Each support system or foundation of each component must be inspected for any detrimental change that could impair support.

§ 193.2611 Fire protection.

(a) Maintenance activities on fire control equipment must be scheduled so that a minimum of equipment is taken out of service at any one time and is returned to service in a reasonable period of time.

(b) Access routes for movement of fire control equipment within each LNG plant must be maintained to reasonably provide for use in all weather conditions.

§ 193.2613 Auxiliary power sources.

Each auxiliary power source must be tested monthly to check its operational capability and tested annually for capacity. The capacity test must take into account the power needed to start up and simultaneously operate equipment that would have to be served by that power source in an emergency.

§ 193.2615 Isolating and purging.

(a) Before personnel begin maintenance activities on components handling flammable fluids which are isolated for maintenance, the component must be purged in accordance with a procedure which meets the requirements of AGA "Purging Principles and Practices," unless the maintenance procedures under § 193.2605 provide that the activity can be safely performed without purging.

(b) If the component or maintenance activity provides an ignition source, a technique in addition to isolation valves (such as removing spool pieces or valves and blank flanging the piping, or double block and bleed valving) must be used to ensure that the work area is free of flammable fluids.

§ 193.2617 Repairs.

(a) Repair work on components must be performed and tested in a manner which—

(1) As far as practicable, complies with the applicable requirements of Subpart D of this part; and

(2) Assures the integrity and operational safety of the component being repaired.

(b) For repairs made while a component is operating, each operator shall include in the maintenance procedures under § 193.2605 appropriate precautions to maintain the safety of personnel and property during repair activities.

§ 193.2619 Control systems.

(a) Each control system must be properly adjusted to operate within design limits.

(b) If a control system is out of service for 30 days or more, it must be inspected and tested for operational capability before returning it to service.

(c) Control systems in service, but not normally in operation (such as relief valves and automatic shutdown devices), must be inspected and tested once each calendar year, but with intervals not exceeding 15 months, with the following exceptions:

(1) Control systems used seasonally, such as for liquefaction or vaporization, must be inspected and tested before use each season.

(2) Control systems that are intended for fire protection must be inspected and tested at regular intervals not to exceed 6 months.

(d) Control systems that are normally in operation, such as required by a base load system, must be inspected and tested once each calendar year but with intervals not exceeding 15 months.

(e) Relief valves must be inspected and tested for verification of the valve seat lifting pressure and reseating.

§ 193.2621 Testing transfer hoses.

Hoses used in LNG or flammable refrigerant transfer systems must be—

(a) Tested once each calendar year, but with intervals not exceeding 15 months, to the maximum pump pressure or relief valve setting; and

(b) Visually inspected for damage or defects before each use.

§ 193.2623 Inspecting LNG storage tanks.

Each LNG storage tank must be inspected or tested to verify that each of the following conditions does not impair the structural integrity or safety or the tank:

(a) Foundation and tank movement during normal operation and after a major meteorological or geophysical disturbance.

(b) Inner tank leakage.

(c) Effectiveness of insulation.

(d) Frost heave.

§ 193.2625 Corrosion protection.

(a) Each operator shall determine which metallic components could, unless corrosion is controlled, have their integrity or reliability adversely affected by external, internal, or atmospheric corrosion during their intended service life.

(b) Components whose integrity or reliability could be adversely affected by corrosion must be either—

(1) Protected from corrosion in accordance with §§ 193.2627 through 193.2635, as applicable; or

(2) Inspected and replaced under a program of scheduled maintenance in accordance with procedures established under § 193.2605.

§ 193.2627 Atmospheric corrosion control.

Each exposed component that is subject to atmospheric corrosive attack must be protected from atmospheric corrosion by—

(a) Material that has been designed and selected to resist the corrosive atmosphere involved; or

(b) Suitable coating or jacketing.

§ 193.2629 External corrosion control; buried or submerged components.

(a) Each buried or submerged component that is subject to external corrosive attack must be protected from external corrosion by—

(1) Material that has been designed and selected to resist the corrosive environment involved; or

(2) The following means:

(i) An external protective coating designed and installed to prevent corrosion attack and to meet the requirements of § 192.461 of this chapter; and

(ii) A cathodic protection system designed to protect components in their entirety in accordance with the requirements of § 192.463 of this chapter and placed in operation before October 23, 1981, or within 1 year after the component is constructed or installed, whichever is earlier.

(b) Where cathodic protection is applied, components that are electrically interconnected must be protected as a unit.

§ 193.2631 Internal corrosion control.

Each component that is subject to internal corrosive attack must be protected from internal corrosion by—

(a) Material that has been designed and selected to resist the corrosive fluid involved; or

(b) Suitable coating, inhibitor, or other means.

§ 193.2633 Interference currents.

(a) Each component that is subject to electrical current interference must be protected by a continuing program to minimize the detrimental effects of currents.

(b) Each cathodic protection system must be designed and installed so as to minimize any adverse effects it might cause to adjacent metal components.

(c) Each impressed current power source must be installed and maintained to prevent adverse interference with communications and control systems.

§ 193.2635 Monitoring corrosion control.

Corrosion protection provided as required by this subpart must be periodically monitored to give early recognition of ineffective corrosion protection, including the following, as applicable:

(a) Each buried or submerged component under cathodic protection must be tested at least once each calendar year, but with intervals not exceeding 15 months, to determine whether the cathodic protection meets the requirements of § 192.463 of this chapter.

(b) Each cathodic protection rectifier or other impressed current power source must be inspected at least 6 times each calendar year, but with intervals not exceeding 2½ months, to ensure that it is operating properly.

(c) Each reverse current switch, each diode, and each interference bond whose failure would jeopardize component protection must be electrically checked for proper performance at least 6 times each calendar year, but with intervals not exceeding 2½ months. Each other interference bond must be checked at least once each calendar year, but with intervals not exceeding 15 months.

(d) Each component that is protected from atmospheric corrosion must be inspected at intervals not exceeding 3 years.

(e) If a component is protected from internal corrosion, monitoring devices designed to detect internal corrosion, such as coupons or probes, must be located where corrosion is most likely to occur. However, monitoring is not required for corrosion resistant materials if the operator can demonstrate that the component will not be adversely affected by internal corrosion during its service life. Internal corrosion control monitoring devices must be checked at least two times each calendar year, but with intervals not exceeding 7½ months.

§ 193.2637 Remedial measures.

Prompt corrective or remedial action must be taken whenever an operator learns by inspection or otherwise that atmospheric, external, or internal corrosion is not controlled as required by this subpart.

§ 193.2639 Maintenance records.

(a) Each operator shall keep a record at each LNG plant of the date and type of each maintenance activity performed on each component to meet the requirements of this subpart, including periodic tests and inspections, for a period of not less than five years.

(b) Each operator shall maintain records or maps to show the location of cathodically protected components, neighboring structures bonded to the cathodic protection system, and corrosion protection equipment.

(c) Each of the following records must be retained for as long as the LNG facility remains in service:

(1) Each record or map required by paragraph (b) of this section.

(2) Records of each test, survey, or inspection required by this subpart in sufficient detail to demonstrate the adequacy of corrosion control measures.

Subpart H—Personnel Qualifications and Training

AUTHORITY: 49 U.S.C. 1674(a); 49 CFR 1.53 and Appendix A to Part 1.

SOURCE: Sections 193.2707—193.2719 appear at 45 FR 70404, Oct. 23, 1980 (Amdt. 193-2), unless otherwise noted.

§ 193.2701 Scope.

This subpart prescribes requirements for personnel qualifications and training.

[45 FR 9219, Feb. 11, 1980]

§ 193.2703 Design and fabrication.

For the design and fabrication of components, each operator shall use—

(a) With respect to design, persons who have demonstrated competence by training or experience in the design of comparable components.

(b) With respect to fabrication, persons who have demonstrated competence by training or experience in the fabrication of comparable components.

[45 FR 9219, Feb. 11, 1980]

§ 193.2705 Construction, installation, inspection, and testing.

(a) Supervisors and other personnel utilized for construction, installation, inspection, or testing must have demonstrated their capability to perform satisfactorily the assigned function by appropriate training in the methods and equipment to be used or related experience and accomplishments.

(b) Each operator must periodically determine whether inspectors performing duties under § 193.2307 are satisfactorily performing their assigned function.

[45 FR 9219, Feb. 11, 1980]

§ 193.2707 Operations and maintenance.

(a) Each operator shall utilize for operation or maintenance of components only those personnel who have demonstrated their capability to perform their assigned functions by—

(1) Successful completion of the training required by §§ 193.2713 and 193.2717; and

(2) Experience related to the assigned operation or maintenance function; and

(3) Acceptable performance on a proficiency test relevant to the assigned function.

(b) A person who does not meet the requirements of paragraph (a) of this section may operate or maintain a component when accompanied and directed by an individual who meets the requirements.

(c) Corrosion control procedures under § 193.2605(b), including those for the design, installation, operation, and maintenance of cathodic protection systems, must be carried out by, or under the direction of, a person qualified by experience and training in corrosion control technology.

§ 193.2709 Security.

Personnel having security duties must be qualified to perform their assigned duties by successful completion of the training required under § 193.2715.

§ 193.2711 Personnel health.

Each operator shall follow a written plan to verify that personnel assigned operating, maintenance, security, or fire protection duties at the LNG plant do not have any physical condition that would impair performance of their assigned duties. The plan must be designed to detect both readily observable disorders, such as physical handicaps or injury, and conditions requiring professional examination for discovery.

§ 193.2713 Training; operations and maintenance.

(a) Each operator shall provide and implement a written plan of initial training to instruct—

(1) All permanent maintenance, operating, and supervisory personnel—

(i) About the characteristics and hazards of LNG and other flammable fluids used or handled at the facility, including, with regard to LNG, low temperatures, flammability of mixtures with air, odorless vapor, boiloff characteristics, and reaction to water and water spray;

(ii) About the potential hazards involvd in operating and maintenance activities; and

(iii) To carry out aspects of the operating and maintenance procedures under §§ 193.2503 and 193.2605 that relate to their assigned functions; and

(2) All personnel—

(i) To carry out the emergency procedures under § 193.2509 that relate to their assigned functions; and

(ii) To give first-aid; and

(3) All operating and appropriate supervisory personnel—

(i) To understand detailed instructions on the facility operations, including controls, functions, and operating procedures; and

(ii) To understand the LNG transfer procedures provided under § 193.2513.

(b) A written plan of continuing instruction must be conducted at intervals of not more than two years to keep all personnel current on the knowledge and skills they gained in the program of initial instruction.

§ 193.2715 Training; security.

(a) Personnel responsible for security at an LNG plant must be trained in accordance with a written plan of initial instruction to:

(1) Recognize breaches of security;

(2) Carry out the security procedures under § 193.2903 that relate to their assigned duties;

(3) Be familiar with basic plant operations and emergency procedures, as

necessary to effectively perform their assigned duties; and

(4) Recognize conditions where security assistance is needed.

(b) A written plan of continuing instruction must be conducted at intervals of not more than two years to keep all personnel having security duties current on the knowledge and skills they gained in the program of initial instruction.

§ 193.2717 Training; fire protection.

(a) All personnel involved in maintenance and operations of an LNG plant, including their immediate supervisors, must be trained in accordance with a written plan of initial instruction, including plant fire drills, to:

(1) Know and follow the fire prevention procedures under § 193.2805(b);

(2) Know the potential causes and areas of fire determined under § 193.2805(a);

(3) Know the types, sizes, and predictable consequences of fire determined under § 193.2817(a); and

(4) Know and be able to perform their assigned fire control duties according to the procedures established under § 193.2509 and by proper use of equipment provided under § 193.2817.

(b) A written plan of continuing instruction, including plant fire drills, must be conducted at intervals of not more than two years to keep personnel current on the knowledge and skills they gained in the instruction under paragraph (a) of the section.

§ 193.2719 Training; records.

(a) Each operator shall maintain a system of records which—

(1) Provide evidence that the training programs required by this subpart have been implemented; and

(2) Provide evidence that personnel have undergone and satisfactorily completed the required training programs.

(b) Records must be maintained for one year after personnel are no longer assigned duties at the LNG plant.

Subpart I—Fire Protection

AUTHORITY: 49 U.S.C. 1674(a); 49 CFR 1.53 and Appendix A to Part 1.

SOURCE: Amdt. 193-2, 45 FR 70408, Oct. 23, 1980, unless otherwise noted.

§ 193.2801 Scope.

This subpart prescribes requirements for fire prevention and fire control at LNG plants other than waterfront LNG plants.

§ 193.2803 General.

Each operator shall use sound fire protection engineering principles to minimize the occurrence and consequences of fire.

§ 193.2805 Fire prevention plan.

(a) Each operator shall determine—

(1) Those potential sources of ignition located inside and adjacent to the LNG plant which could cause fires that affect the safety of the plant; and

(2) Those areas, as described in section 500-4 of MFPA-70, where the potential exists for the presence of flammable fluids in an LNG plant. Determinations made under this paragraph must be kept current.

(b) With respect to areas determined under paragraph (a)(2) of this section, each operator shall include in the operating and maintenance procedures under § 193.2503 and § 193.2605, as appropriate, steps necessary to minimize—

(1) The leakage or release of flammable fluids; and

(2) The possibility of flammable fluids being ignited by sources identified under paragraph (a)(1) of this section.

§ 193.2807 Smoking.

(a) (1) Smoking is prohibited at an LNG plant in areas identified under § 193.2805(a)(2).

(2) Smoking is permitted only in such locations that the operator designates as a smoking area.

(b) Signs marked with the words "smoking permitted" must be displayed in prominent places in each smoking area designated under paragraph (a) of this section.

(c) Signs marked with the words "NO SMOKING" must be displayed in prominent places in areas where smoking is prohibited.

§ 193.2809 Open fires.

(a) No open fires are permitted at an LNG plant, except at flare stacks and at times and places designated by the operator.

(b) Whenever an open fire is designated, there must be at the site of the fire—

(1) Trained fire fighting personnel; and

(2) Fire control equipment which has the capability of extinguishing the fire.

(c) The fire fighting personnel and equipment must remain at the fire site until the fire is extinguishd and there is no possibility of reignition.

§ 193.2811 Hotwork.

Welding, flame cutting, and similar operations are prohibited, except at times and places that the operator designates in writing as safe and when constantly supervised in accordance with NFPA-51B.

§ 193.2813 Storage of flammable fluids.

Flammable fluids may not be stored in areas where ignition sources are present, unless stored in accordance with the requirements of Chapter 4 of NFPA 30.

§ 193.2815 Motorized equipment.

Use of motor vehicles and other motorized equipment which constitute potential ignition sources is prohibited in an impounding space, in areas within 15 m (49.2 ft) of a storage tank, and in areas within 15 m (49.2 ft) of processing equipment containing a flammable fluid except—

(a) At times the operator designates in writing as safe; and

(b) When the motorized equipment is constantly attended.

§ 193.2817 Fire equipment.

(a) Each operator shall determine: (1) the types and sizes of fires that may reasonably be expected to occur within and adjacent to each LNG plant that could affect the safety of components; and

(2) The foreseeable consequences of these fires, including the failure of components or buildings due to heat exposure.

(b) Each operator shall provide and maintain fire control equipment and supplies in accordance with the applicable requirements of NFPA 59A to protect or cool components that could fail due to heat exposure from fires determined under paragraph (a) of this section and either worsen an emergency or endanger persons or property located outside the plant. Protection or cooling must be provided for as long as the heat exposure exists. The fire control equipment and supplies must include the following:

(1) Portable fire extinguishers suitable for types of fires identified under paragraph (a) of this section; and

(2) If the total inventory of LNG is 265 m^3 (70,000 gal.) or more, a water supply and associated delivery system.

(c) Each operator shall determine the type, size, quantity and location of the fire control equipment and supplies required under paragraph (b) of this section.

(d) Each operator shall provide each facility person who may be endangered by exposure to fire or the products of combustion in performing fire control duties protective clothing and equipment, including, if necessary, a self-contained breathing apparatus.

(e) Portable fire control equipment, protective clothing and equipment for personnel use, controls for fixed fire control equipment, and fire control supplies must be conspicuously located, marked for easy recognition, and readily available for use.

(f) Fire control equipment must have operating instructions. Instructions must be attached to portable equipment and placed at the location of controls for fixed equipment.

EFFECTIVE DATE NOTE: Section 193.2817 becomes effective Jan. 1, 1982. See Amdt. 193-2, 45 FR 70390, Oct. 23, 1980.

§ 193.2819 Gas detection.

(a) All areas determined under § 193.2805(a)(2) in which a hazard to persons or property could exist must be continuously monitored for the presence of flammable gases and vapors with fixed flammable gas detection systems provided and maintained according to the applicable requirements of NFPA 59A.

(b) Each fixed flammable gas detection system must be provided with audible and visible alarms located at an attended control room or control station, and an audible alarm in the area of gas detection.

(c) Flammable gas detection alarms must be set to activate at not more than 25 percent of the lower flammable limit of the gas or vapor being monitored.

(d) Gas detection systems must be installed so that they can be readily tested as required by NFPA 59A.

(e) A minimum of two portable flammable gas detectors capable of measuring the lower flammable limit must be available at the LNG plant for use at all times.

(f) All enclosed buildings located on an LNG plant must be continuously monitored for the presence of flammable gases and vapors with a fixed flammable gas detection system that provides a visible or audible alarm outside the enclosed building. The systems must be provided and maintained according to the applicable requirements of NFPA 59A.

EFFECTIVE DATE NOTE: Section 193.2819 becomes effective Jan. 1, 1982. See Amdt. 193-2, 45 FR 70390, Oct. 23, 1980.

§ 193.2821 Fire detection.

(a) Fire detectors that continuously monitor for the presence of either flame, heat, or products of combustion must be provided in all areas determined under § 193.2805(a)(2) in which a hazard to persons or property could exist and in all other areas that are used for the storage of flammable or combustible material.

(b) Each fire detection system must be provided with audible and visible alarms located at an attended control room or control station, and an audible alarm in the area of fire detection. The systems must be provided and maintained according to the applicable requirements of NFPA 59A.

EFFECTIVE DATE NOTE: Section 193.2821 becomes effective Jan. 1, 1982. See Amdt. 193-2, 45 FR 70390, Oct. 23, 1980.

Subpart J—Security

AUTHORITY: 49 U.S.C. 1674(a); 49 CFR 1.53 and Appendix A to Part 1.

SOURCE: Amdt. 193-2, 45 FR 70409, Oct. 23, 1980, unless otherwise noted.

§ 193.2901 Scope.

This subpart prescribes requirements for security at LNG plants other than waterfront LNG plants.

§ 193.2903 Security procedures.

Each operator shall prepare and follow one or more manuals of written procedures to provide security for each LNG plant. The procedures must be available at the plant in accordance with § 193.2017 and include at least:

(a) A description and schedule of security inspections and patrols performed in accordance with § 193.2913;

(b) A list of security personnel positions or responsibilities utilized at the LNG plant;

(c) A brief description of the duties associated with each security personnel position or responsibility;

(d) Instructions for actions to be taken, including notification of other appropriate plant personnel and law enforcement officials, when there is any indication of an actual or attempted breach of security;

(e) Methods for determining which persons are allowed access to the LNG plant;

(f) Positive identification of all persons entering the plant and on the plant, including methods at least as effective as picture badges; and

(g) Liaison with local law enforcement officials to keep them informed about current security procedures under this section.

§ 193.2905 Protective enclosures.

(a) The following facilities must be surrounded by a protective enclosure:

(1) Storage tanks;
(2) Impounding systems;
(3) Vapor barriers;
(4) Cargo transfer systems;
(5) Process, liquefaction, and vaporization equipment;
(6) Control rooms and stations;
(7) Control systems;

(8) Fire control equipment;

(9) Security communications systems; and

(10) Alternative power sources.

The protective enclosure may be one or more separate enclosures surrounding a single facility or multiple facilities.

(b) Ground elevations outside a protective enclosure must be graded in a manner that does not impair the effectiveness of the enclosure.

(c) Protective enclosures may not be located near features outside of the facility, such as trees, poles, or buildings, which could be used to breach the security.

(d) At least two accesses must be provided in each protective enclosure and be located to minimize the escape distance in the event of emergency.

(e) Each access must be locked unless it is continuously guarded. During normal operations, an access may be unlocked only by persons designated in writing by the operator. During an emergency, a means must be readily available to all facility personnel within the protective enclosure to open each access.

EFFECTIVE DATE NOTE: Section 193.2905 becomes effective Jan. 1, 1982. See Amdt. 193-2, 45 FR 70390, Oct. 23, 1980.

§ 193.2907 Protective enclosure construction.

(a) Each protective enclosure must have sufficient strength and configuration to obstruct unauthorized access to the facilities enclosed.

(b) Protective enclosures must be fences or walls constructed as follows:

(1) Fences must be chainlink security fences constructed of No. 11 American wire gauge or heavier metal wire.

(2) Walls must be vertical and constructed of stone, brick, cinder block, concrete, steel or comparable materials.

(3) Protective enclosures must be topped by three or more strands of barbed wire or similar materials on brackets angled outward between 30° and 45° from the vertical, with a height of at least 2.4m (8 ft.) including approximately one foot of barbed topping.

(4) Openings in or under protective enclosures must be secured by grates, doors or covers of construction and fastening of sufficient strength such that the integrity of the protective enclosure is not reduced by any opening.

(c) Paragraphs (b) (1) through (3) of this section do not apply to protective enclosures constructed before October 23, 1980.

(1) Are made of noncombustible materials;

(2) Are at least 2.1m (7 ft.) in height including approximately one foot of barbed or similar topping; and

(3) Have served to protect the LNG plant without having been breached during their history of service.

EFFECTIVE DATE NOTE: Section 193.2907 becomes effective Jan. 1, 1982. See Amdt. 193-2, 45 FR 70390, Oct. 23, 1980.

§ 193.2909 Security communications.

A means must be provided for:

(a) Prompt communications between personnel having supervisory security duties and law enforcement officials; and

(b) Direct communications between all on-duty personnel having security duties and all control rooms and control stations.

EFFECTIVE DATE NOTE: Section 193.2909 becomes effective Jan. 1, 1982. See Amdt. 193-2, 45 FR 70390, Oct. 23, 1980.

§ 193.2911 Security lighting.

Where security warning systems are not provided for security monitoring under § 193.2913, the area around the facilities listed under § 193.2905(a) and each protective enclosure must be illuminated with a minimum in service lighting intensity of not less than 2.2 lux (0.2 ft^c) between sunset and sunrise.

EFFECTIVE DATE NOTE: Section 193.2911 becomes effective Jan. 1, 1982. See Amdt. 193-2, 45 FR 70390, Oct. 23, 1980.

§ 193.2913 Security monitoring.

Each protective enclosure and the area around each facility listed in § 193.2905(a) must be monitored for the presence of unauthorized persons. Monitoring must be by visual observation in accordance with the schedule in the security procedures under

§ 193.2903(a) or by security warning systems that continuously transmit data to an attended location. At an LNG plant with less than 40,000 m^3 (250,000 bbl) of storage capacity, only the protective enclosure must be monitored.

§ 193.2915 Alternative power sources.

An alternative source of power that meets the requirements of § 193.2445 must be provided for security lighting and security monitoring and warning systems required under §§ 193.2911 and 193.2913.

EFFECTIVE DATE NOTE: Section 193.2915 becomes effective Jan. 1, 1982. See Amdt. 193-2, 45 FR 70390, Oct. 23, 1980.

§ 193.2917 Warning signs.

(a) Warning signs must be conspicuously placed along each protective enclosure at intervals so that at least one sign is recognizable at night from a distance of 39m (100 ft.) from any way that could reasonably be used to approach the enclosure.

(b) Signs must be marked with at least the following on a background of sharply contrasting color:

The words "NO TRESPASSING," or words of comparable meaning.

APPENDIX A TO PART 193—INCORPORATION BY REFERENCE

I. List of Organizations and Addresses

A. American Concrete Institute (ACI), P.O. Box 19150, Redford Station, Detroit, Michigan 48219.

B. American Gas Association (AGA), 1515 Wilson Boulevard, Arlington, Virginia 22209.

C. American National Standards Institute (ANSI), 1430 Broadway, New York, New York 10018.

D. American Petroleum Institute (API), 2101 L Street, NW., Washington, D.C. 20037.

E. American Society of Mechanical Engineers (ASME), United Engineering Center, 345 East 47th Street, New York, New York 10017.

F. National Fire Protection Association (NFPA), 470 Atlantic Avenue, Boston, Massachusetts 02210.

G. International Conference of Building Officials, 5360 South Workman Hill Road, Whittier, California 90601.

II. Documents Incorporated by Reference

A. American Concrete Institute (ACI)

1. ACI Standard 311-75—Recommended Practice for Concrete Inspection, (1975 edition).

B. American Gas Association (AGA)

1. Evaluation of LNG Vapor Control Methods. (October 1974 edition).

2. Purging Principles and Practice (1975 edition).

C. American National Standards Institute (ANSI)

1. ANSI A 58.1 Building Code Requirements for Minimum Design Loads in Buildings and Other Structures.

D. American Petroleum Institute (API)

1. API 620-Recommended Rules for Design and Construction of Large, Welded, Low Pressure Storage Tanks (6th edition, July 1977).

2. API 1104 Standard for Welding Pipelines and Related Facilities (14 edition, 1977).

3. API 6D Specifications for Pipeline Valves (17 edition, 1977).

E. American Society of Mechanical Engineers (ASME)

1. ANSI B31.3 Chemical and Plant Petroleum Refinery Piping (1973 edition).

2. ASME Boiler and Pressure Vessel Code, Section 1 Power Boilers (1977 edition).

3. ASME Boiler and Pressure Vessel Code, Section 8 Division 1 (1977 edition).

4. ASME Boiler and Pressure Vessel Code, Section 8 Division 2, Alternative Rules (1977 edition).

5. ASME Boiler and Pressure Vessel Code, Section 9 Welding and Brazing Qualifications (1977 edition).

6. ASME Boiler and Pressure Vessel Code, Section 4 Heating Boilers.

7. ANSI B31.5 Refrigeration Piping (1974 edition).

8. ANSI B31.8 Gas Transmission and Distribution Piping Systems (1975 edition).

F. International Conference of Building Officials

1. UBC, Uniform Building Code (1979 edition).

G. National Fire Protection Association (NFPA)

1. NFPA No. 37 Stationary Combustion Engine and Gas Turbines (1979 edition).

2. NFPA No. 59A Storage and Handling of LNG (1979 edition).

2. NFPA No. 59A, Storage and Handling of LNG (1972 edition for § 193.2005(c), otherwise 1979 edition).

3. NFPA No. 70 National Electric Code (1978 edition).

4. NFPA No. 30 Flammable Liquids.

4. NFPA No. 30, Flammable Liquids (1977 edition).

5. NFPA No. 51 B, Cutting and Welding Processes (1977 edition).

(49 U.S.C. 1674 (a); 49 CFR 1.53 and Appendix A to Part 1)

[45 FR 9203, Feb. 11, 1980, as amended by Amdt. 193-2, 45 FR 70410, Oct. 23, 1980]

PART 195—TRANSPORTATION OF HAZARDOUS LIQUIDS BY PIPELINE

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AUTHORITY: Sec. 203, Pub. L. 96-129, 93 Stat. 1004, 49 U.S.C. 2002; 49 CFR 1.53 and Appendix A to Part 1.

SOURCE: Amdt. 195-22, 46 FR 38360, July 27, 1981, unless otherwise noted.

Subpart A—General

§ 195.0 Scope.

This part prescribes safety standards and accident reporting requirements for pipeline facilities used in the transportation of hazardous liquids.

§ 195.1 Applicability.

(a) Except as provided in paragraph (b) of this section, this part applies to the following pipeline facilities and the transportation of hazardous liquids associated with those facilities—

(1) Those which are subject to the jurisdiction of the Federal Energy Regulatory Commission under the authority vested in the Commission by section 402(b) of the Department of Energy Organization Act (91 Stat. 584, 42 U.S.C. 7172(b)), and

(2) Those which are on the Outer Continental Shelf.

(b) This part does not apply to—

(1) Transportation of a hazardous liquid that is transported in a gaseous state;

(2) Transportation of a hazardous liquid through a pipeline by gravity;

(3) Transportation of a hazardous liquid through pipelines that operate at a stress level of 20 percent or less of the specified minimum yield strength of the line pipe;

(4) Transportation of a hazardous liquid in onshore pipelines in rural areas between a production facility and an operator trunkline reception point;

(5) Transportation of a hazardous liquid in offshore pipelines which are located upstream from the outlet flange of each facility on the Outer Continental Shelf where hydrocarbons are produced or where produced hydrocarbons are first separated, dehydrated, or otherwise processed whichever facility is farther downstream;

(6) Transportation of a hazardous liquid through onshore production, refining, or manufacturing facilities or storage or in-plant piping systems associated with such facilities;

(7) Transportation of a hazardous liquid by vessel, aircraft, tank truck, tank car, or other vehicle or terminal facilities used exclusively to transfer hazardous liquids between such modes of transportation.

§ 195.2 Definitions.

As used in this part—

"Barrel" means a unit of measurement equal to 42 U.S. standard gallons.

"Breakout tank" means a tank used to (a) relieve surges in a hazardous liquid pipeline system or (b) receive and store hazardous liquid transported by a pipeline for reinjection and continued transportation by pipeline.

"Component" means any part of a pipeline which may be subjected to pump pressure including, but not limited to, pipe, valves, elbows, tees, flanges, and closures.

"Hazardous liquid" means petroleum, petroleum products, and anhydrous ammonia.

"Highly volatile liquid" or "HVL" means a hazardous liquid which will form a vapor cloud when released to the atmosphere and which has a vapor pressure exceeding 276 kPa (40 psia) at 37.8° C (100° F).

"Line section" means a continuous run of pipe between adjacent pressure pump stations, between a pressure pump station and terminal or breakout tanks, between a pressure pump station and a block valve, or between adjacent block valves.

"Nominal wall thickness" means the wall thickness listed in the pipe specifications.

"Offshore" means beyond the line of ordinary low water along that portion of the coast of the United States that is in direct contact with the open seas and beyond the line marking the seaward limit of inland waters.

"Operator" means a person who owns or operates pipeline facilities.

"Person" means any individual, firm, joint venture, partnership, corporation, association, State, municipality, cooperative association, or joint stock association, and includes any trustee, receiver, assignee, or personal representative thereof.

"Pipe" or "line pipe" means a tube, usually cylindrical, through which a hazardous liquid flows from one point to another.

"Pipeline" or "pipeline system" means all parts of a pipeline facility through which a hazardous liquid moves in transportation, including, but not limited to, line pipe, valves and other appurtenances connected to line pipe, pumping units, fabricated assemblies associated with pumping units, metering and delivery stations and fabricated assemblies therein, and breakout tanks.

"Pipeline facility" means new and existing pipe, rights-of-way, and any equipment, facility, or building used in the transportation of hazardous liquids.

"Secretary" means the Secretary of Transportation or any person to whom he has delegated authority in the matter concerned.

"Specified minimum yield strength" means the minimum yield strength, expressed in pounds per square inch, prescribed by the specification under which the material is purchased from the manufacturer.

"Stress level" means the level of tangential or hoop stress, usually expressed as a percentage of specified minimum yield strength.

"Surge pressure" means pressure produced by a change in velocity of the moving stream that results from shutting down a pump station or pumping unit, closure of a valve, or any other blockage of the moving stream.

§ 195.3 Matter incorporated by reference.

(a) There are incorporated by reference in this part all materials referred to in this part. Those materials are hereby made a part of this regulation. Applicable editions are listed in paragraph (c) of this section in parentheses following the title of the referenced material. Earlier editions listed in previous editions of this section may be used for components manufactured, designed, or installed in accordance with those earlier editions at the time they were listed. The user must refer to the appropriate previous edition of 49 CFR for a listing of the earlier listed editions.

(b) All incorporated materials are available for inspection in the Materials Transportation Bureau, Washington, D.C., and at the Office of the Federal Register, 1100 L Street, N.W., Washington, D.C. These materials have been approved for incorporation by reference by the Director of the Federal Register. In addition, materials incorporated by reference are available as follows:

(1) American Petroleum Institute (API), 2101 L Street, N.W., Washington, D.C. 20037, or 211 North Avery, Suite 1700, Dallas, Texas 75201.

(2) The American Society of Mechanical Engineers (ASME), United Engineering Center, 345 East 47th Street, New York, N.Y. 10017.

(3) Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 5203 Leesburg Pike, Suite 502, Falls Church, Va. 22041.

(4) American National Standards Institute (ANSI), 1430 Broadway, New York, N.Y. 10018.

(5) American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pa. 19103.

(c) The full title for the publications incorporated by reference in this part are as follows:

(1) American Petroleum Institute:

(i) API Specification 6D "API Specification for Pipeline Valves," which may be obtained from the Dallas office (1977).

(ii) API Specification 1104 "Standard for Welding Pipe Lines and Related Facilities" (1980).

(iii) API Specification 5L "API Specification for Line Pipe" (1980).

(iv) API Specification 5LS "API Specification for Spiral-Weld Line Pipe" (1980).

(v) API Specification 5LX "API Specification for High-Test Line Pipe" (1980).

(2) ASME Code is the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels, Division 1" (1977).

(3) Manufacturers Standardization Society of the Valve and Fitting Industry:

MSS SP-75, Specification for High-Test Wrought Weldings Fittings (1976).

(4) American National Standards Institute:

(i) ANSI B16.9 "Factory Made Wrought Steel Butt-Welding Fittings" (1978).

(ii) ANSI B31.4 "Liquid Petroleum Transportation Piping Systems" (1979).

(5) American Society for Testing and Materials:

(i) ASTM Specification A53 "Standard Specification for Welded and Seamless Steel Pipe" (1979).

(ii) ASTM Specification A106 "Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service" (1979b).

(iii) ASTM Specification A134 "Standard Specification for Electric-Fusion (Arc)-Welded Steel Plate Pipe, Size 16 in. and Over" (1974).

(iv) ASTM Specification A135 "Standard Specification for Electric-Resistance Welded Steel Pipe" (1979).

(v) ASTM Specification A139 "Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe, Sizes 4 inch and over" (1974).

(vi) ASTM Specification A671 "Electric-Fusion-Welded Steel Pipe For Atmospheric and Lower Temperatures" (1977).

(vii) ASTM Specification A672 "Electric-Fusion-Welded Steel Pipe For High Pressure Service At Moderate Temperatures" (1979).

(viii) ASTM Specification A691 "Carbon and Alloy Steel Pipe Electric-Fusion-Welded For High Pressure Service At High Temperatures" (1979).

(ix) ASTM Specification A211 "Standard Specification for Spiral-Welded Steel or Iron Pipe" (1975).

(x) ASTM Specification A333 "Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service" (1979).

(xi) ASTM Specification A381 "Standard Specification for Metal-Arc-Welded Steel Pipe for High Pressure Transmission Systems" (1979).

§ 195.4 Compatibility necessary for transportation of hazardous liquids.

No person may transport any hazardous liquid unless the hazardous liquid is chemically compatible with both the pipeline, including all components, and any other commodity that it may come into contact with while in the pipeline.

§ 195.5 Conversion to service subject to this part.

(a) A steel pipeline previously used in service not subject to this part qualifies for use under this part if the operator prepares and follows a written procedure to accomplish the following:

(1) The design, construction, operation, and maintenance history of the pipeline must be reviewed and, where sufficient historical records are not available, appropriate tests must be performed to determine if the pipeline is in a satisfactory condition for safe operation.

(2) The pipeline right-of-way, all aboveground segments of the pipeline, and appropriately selected underground segments must be visually inspected for physical defects and operating conditions which reasonably could be expected to impair the strength or tightness of the pipeline.

(3) All known unsafe defects and conditions must be corrected in accordance with this part.

(4) The pipeline must be tested in accordance with the Subpart E of this part to substantiate the maximum allowable operating pressure permitted by § 195.406.

(b) A pipeline which qualifies for use under this section need not comply with the corrosion control requirements of this part until 12 months after it is placed in service, notwithstanding any earlier deadlines for compliance. In addition to the requirements of Subpart F of this part, the corrosion control requirements of Subpart D apply to each pipeline which substantially meets those requirements before it is placed in service or which is a segment that is replaced, relocated, or substantially altered.

(c) Each operator must keep for the life of the pipeline a record of the investigations, tests, repairs, replacements, and alterations made under the requirements of paragraph (a) of this section.

§ 195.8 Transportation of hazardous liquids in pipelines constructed with other than steel pipe.

No person may transport any hazardous liquid through a pipe that is constructed after October 1, 1970, of material other than steel unless the person has notified the Secretary in writing at least 90 days before the transportation is to begin. The notice must state the chemical name, common name, properties, and characteristics of the hazardous liquid to be transported and the material used in construction of the pipeline. If the Secretary determines that the transportation of the hazardous liquid in the manner proposed would be unduly hazardous, he will, within 90 days after receipt of the notice order the person that gave the notice, in writing, not to transport the hazardous liquid in the proposed manner until further notice.

§ 195.10 Responsibility of operator for compliance with this part.

An operator may make arrangements with another person for the performance of any action required by this part. However, the operator is not thereby relieved from the responsibility for compliance with any requirement of this part.

Subpart B—Accident Reporting

§ 195.50 Scope.

This subpart prescribes rules governing the reporting of any failure in a pipeline system subject to this part in which there is a release of the hazardous liquid transported resulting in any of the following:

(a) Explosion or fire not intentionally set by the operator.

(b) Loss of 50 or more barrels of liquid.

(c) Escape to the atmosphere of more than five barrels a day of highly volatile liquids.

(d) Death of any person.

(e) Bodily harm to any person resulting in one or more of the following:

(1) Loss of consciousness.

(2) Necessity to carry the person from the scene.

(3) Necessity for medical treatment.

(4) Disability which prevents the discharge of normal duties or the pursuit of normal activities beyond the day of the accident.

(f) Estimated property damage to the property of the operator or others, or both, exceeding $5,000.

§ 195.52 Telephonic notice of certain accidents.

(a) At the earliest practicable moment following discovery of a release of the hazardous liquid transported resulting in an event described in § 195.50, the operator of the system shall give notice, in accordance with paragraph (b) of this section, of any failure that—

(1) Caused a death or a personal injury requiring hospitalization;

(2) Resulted in either a fire or explosion not intentionally set by the operator;

(3) Caused estimated damage to the property of the operator or others, or both, exceeding $5,000;

(4) Resulted in pollution of any stream, river, lake, reservoir, or other similar body of water that violated applicable water quality standards, caused a discoloration of the surface of the water or adjoining shoreline, or deposited a sludge or emulsion beneath the surface of the water or upon adjoining shorelines; or

(5) In the judgment of the operator was significant even though it did not meet the criteria of any other paragraph of this section.

(b) Reports made under paragraph (a) of this section are made by telephone to area code 202, 426-0700 and must include the following information:

(1) Name and address of the operator.

(2) Name and telephone number of the reporter.

(3) The location of the failure.

(4) The time of the failure.

(5) The fatalities and personal injuries, if any.

(6) All other significant facts known by the operator that are relevant to the cause of the failure or extent of the damages.

§ 195.54 Accident reporting.

Each carrier that experiences an accident that is required to be reported under this subpart shall, as soon as practicable but not later than 15 days after discovery of the accident, prepare and file an accident report, on DOT Form 7000-1 or a facsimile, with the Chief, Information Systems Division, Transportation Programs Bureau, Department of Transportation, Washington, D.C. 20590. The operator shall file two copies of each report and shall retain one copy at its principal place of business.

§ 195.56 Instructions for preparing DOT Form 7000-1.

(a) Each operator shall prepare each report of an accident on DOT Form 7000-1 or a facsimile, in accordance with the following instructions:

(1) *General.* Each applicable item must be marked or filled in as fully and as accurately as information accessible to the operator at the time of filing the report will permit.

(2) *Part A.* Enter name as it is filed with the Federal Energy Regulatory Commission. If the operator's name is not filed with the Commission, enter the complete corporate name of the operator. Enter the address of the operator's principal place of business including zip code.

(3) *Part B, Item 1.* Enter the date the accident occurred or was discovered. If the accident was not discovered on the date it occurred, state this fact on the back of the form.

(4) *Part B, Item 2.* Enter the exact time in hours and minutes (i.e., 10:15) if known or a time range (i.e., 10:11) if exact time is not known. If the accident was not discovered on the date it occurred, enter the time it was discovered and state this fact, on the back of the form as in Part B, Item 1.

(5) *Part B, Item 3.* Enter all three names, State, county, city, or town, in or near which accident occurred.

(6) *Part B, Item 4.* Mark the appropriate box. If "other" is marked, state clearly on form what part of the pipeline system.

(7) *Part B, Item 5.* If the accident occurred in an uninhabited area, such as woods, cultivated field, swamp, etc., so state clearly on the form under Item 5. If not, attach a sketch to the form showing the part of the pipeline system where the accident occurred, and the location of the accident as related to significant landmarks. Each item shown on the sketch must be clearly and distinctly marked to identify it. Approximate distances from accident location to all landmarks shown on the sketch must be indicated.

(8) *Part C.* Mark the appropriate box or boxes. If applicable, mark more than one box. If "other" is marked, state clearly on form the exact origin of the release of the hazardous liquid.

(9) *Part D.* Mark the appropriate box. If "other" is marked, clearly state the cause of the accident.

(10) *Part E.* Indicate a number under each heading including "0" if none. Report deaths, even if previously reported in accordance with § 195.52.

(11) *Part F, Items 1 and 2.* Report only material in the pipeline system that was actually damaged such as pipe, valves, or fittings. Do not include cost of hazardous liquid which was lost due to the accident or fittings used during repair which became permanently attached to the system. The dollar value of damage should be based on replacement at present day costs.

(12) *Part F, Items 3 and 4.* This is damage to property of operator or others. Dollar value must be actual or the best estimate available.

(13) *Part G, Item 1.* State the commonly used name of the hazardous liquid, such as fuel oil, regular gasoline, liquefied petroleum gas. If the hazardous liquid name is one not commonly used, state the name here and give a brief description of it under "Account of Accident by Responsible Official of Carrier."

(14) *Part G, Item 3.* State the year facility was installed or the best estimate possible. Pipe is excluded as the year of installation is required in Item 4 of Part H.

(15) *Part H.* Mark appropriate boxes and state information required in all items of this part only if the accident occurred in line pipe. If the accident occurred in any other part of the pipeline system, omit this part.

(16) *Part I.* Mark appropriate boxes and state information required in all items of this part if the accident was caused by corrosion in any component of the pipeline system. In Item 4, state the length of time between the type of tests, such as pipe-to-soil potential, stated in Item 5.

(17) *Part J.* Complete all three items only if the accident was caused by equipment rupturing the pipeline. In Item 2, all the information stated on the closest line marker must be shown.

(b) In addition to the requirements of paragraph (a) of this section, in the space provided after Part J, the operator shall enter an account of the accident containing the most reliable information to which the operator has access at the time of reporting, sufficiently detailed and complete to convey an understanding of the accident. This account may be continued on an extra sheet of paper if more space is needed.

(c) At the bottom of the back of DOT Form 7000-1, the operator shall state the name and title of the pipeline official responsible for compiling and filing the report along with the telephone number at which this official can be reached, and the date the report was completed.

§ 195.58 Changes in or additions to accident report.

Whenever an operator receives any changes in the information reported or additions to the original report on DOT Form 7000-1 it shall immediately file a supplemental report with the Chief, Information Systems Division, Transportation Programs Bureau, Department of Transportation, Washington, D.C. 20590.

§ 195.60 Operator assistance in investigation.

If the Department of Transportation investigates an accident, the operator involved shall make available to the representative of the Department all records and information that in any way pertain to the accident, and shall afford all reasonable assistance in the investigation of the accident.

§ 195.62 Supplies of accident report DOT Form 7000-1.

Each operator shall maintain an adequate supply of forms that are a facsimile of DOT Form 7000-1 to enable it to promptly report accidents. The Department will, upon request, furnish specimen copies of the form. Requests should be addressed to the Chief, Information Systems Division, Transportation Programs Bureau, Department of Transportation, Washington, D.C. 20590.

Subpart C—Design Requirements

§ 195.100 Scope.

This subpart prescribes minimum design requirements for new pipeline systems constructed with steel pipe and for relocating, replacing, or otherwise changing existing systems constructed with steel pipe. However, it does not apply to the movement of line pipe covered by § 195.424.

§ 195.102 Design temperature.

Material for components of the system must be chosen for the temperature environment in which the components will be used so that the pipeline will maintain its structural integrity.

§ 195.104 Variations in pressure.

If, within a pipeline system, two or more components are to be connected at a place where one will operate at a higher pressure than another, the system must be designed so that any component operating at the lower pressure will not be overstressed.

§ 195.106 Internal design pressure.

(a) Internal design pressure for the pipe in a pipeline is determined in accordance with the following formula:

$$P=(2\,St/D)\times E\times F$$

P=Internal design pressure in pounds per square inch gauge.

S=Yield strength in pounds per square inch determined in accordance with paragraph (b) of this section.

t=Nominal wall thickness of the pipe in inches. If this is unknown, it is determined in accordance with paragraph (c) of this section.

D=Nominal outside diameter of the pipe in inches.

E=Seam joint factor determined in accordance with paragraph (e) of this section.

F=A design factor of 0.72, except that a design factor of 0.60 is used for pipe, including risers, on a platform located offshore or on a platform in inland navigable waters, and 0.54 is used for pipe that has been cold worked to meet the specified minimum yield strength and is subsequently heated, other than by welding to 600° F. or more.

(b) The yield strength to be used in determining internal design pressure under paragraph (a) of this section is the specified minimum yield strength. If the specified minimum yield strength is not known, the yield strength is determined by performing all of the tensile tests of either API Standard 5L, 5LS, or 5LX on randomly selected test specimens with the following number of tests:

Pipe size	Number of tests
Less than 6 inches in outside diameter.	One test for each 200 lengths.
6 inches through 12¾ inches in outside diameter.	One test for each 100 lengths.
Larger than 12¾ inches in outside diameter.	One test for each 50 lengths.

If the average yield-tensile ratio exceeds 0.85, the yield strength of the pipe is taken as 24,000 p.s.i. If the average yield-tensile ratio is 0.85 or less, the yield strength of the pipe is taken as the lower of the following:

(1) Eighty percent of the average yield strength determined by the tensile tests.

(2) The lowest yield strength determined by the tensile tests.

(c) If the nominal wall thickness to be used in determining internal design pressure under paragraph (a) of this section is not known, it is determined by measuring the thickness of each piece of pipe at quarter points on one end. However, if the pipe is of uniform grade, size, and thickness, only 10 individual lengths or 5 percent of all lengths, whichever is greater, need be measured. The thickness of the lengths that are not measured must be verified by applying a gage set to the minimum thickness found by the measurement. The nominal wall thickness to be used is the next wall thickness found in commerical specifications that is below the average of all the measurements taken. However, the nominal wall thickness may not be more than 1.14 times the smallest measurement taken on pipe that is less than 20 inches in outside diameter, nor more than 1.11 times the smallest measurement taken on pipe that is 20 inches or more in outside diameter.

(d) The minimum wall thickness of the pipe may not be less than 87.5 percent of the value used for nominal wall thickness in determining the internal design pressure under paragraph (a) of this section. In addition, the anticipated external loads and external pressures that are concurrent with internal pressure must be considered in accordance with §§ 195.108 and 195.110 and, after determining the internal design pressure, the nominal wall thickness must be increased as necessary to compensate for these concurrent loads and pressures.

(e) The seam joint factor used in paragraph (a) of this section is determined in accordance with the following table:

Specification	Pipe class	Seam joint factor
ASTM A53	Seamless	1.00
	Electric resistance welded	1.00
	Furnace lap welded	0.80
	Furnace butt welded	0.60
ASTM A106	Seamless	1.00
ASTM A134	Electric fusion arc welded	0.80
ASTM A135	Electric resistance welded	1.00
ASTM A139	Electric fusion welded	0.80

Specification	Pipe class	Seam joint factor
ASTM A211	Spiral welded pipe	0.80
ASTM A333	Seamless	1.00
	Welded	1.00
ASTM A381	Double submerged arc welded	1.00
ASTM A671	Electric-fusion-welded	1.00
ASTM A672	Electric-fusion-welded	1.00
ASTM A691	Electric-fusion-welded	1.00
APL 5L	Seamless	1.00
	Electric resistance welded	1.00
	Electric flash welded	1.00
	Submerged arc welded	1.00
	Furnace lap welded	0.80
	Furnace butt welded	0.60
API 5LX	Seamless	1.00
	Electric resistance welded	1.00
	Electric flash welded	1.00
	Submerged arc welded	1.00
API 5LS	Electric resistance welded	1.00
	Submerged arc welded	1.00

The seam joint factor for pipe which is not covered by this paragraph must be approved by the Secretary

§ 195.108 External pressure.

Any external pressure that will be exerted on the pipe must be provided for in designing a pipeline system.

§ 195.110 External loads.

(a) Anticipated external loads (e.g.), earthquakes, vibration, thermal expansion, and contraction must be provided for in designing a pipeline system. In providing for expansion and flexibility, section 419 of ANSI B31.4 must be followed.

(b) The pipe and other components must be supported in such a way that the support does not cause excess localized stresses. In designing attachments to pipe, the added stress to the wall of the pipe must be computed and compensated for.

§ 195.112 New pipe.

Any new pipe installed in a pipeline system must comply with the following:

(a) The pipe must be made of steel of the carbon, low alloy-high strength, or alloy type that is able to withstand the internal pressures and external loads and pressures anticipated for the pipeline system.

(b) The pipe must be made in accordance with a written pipe specification that sets forth the chemical requirements for the pipe steel and mechanical tests for the pipe to provide pipe suitable for the use intended.

(c) Each length of pipe with an outside diameter of 4 inches or more must be marked on the pipe or pipe coating with the specification to which it was made, the specified minimum yield strength or grade, and the pipe size. The marking must be applied in a manner that does not damage the pipe or pipe coating and must remain visible until the pipe is installed.

§ 195.114 Used pipe.

Any used pipe installed in a pipeline system must comply with § 195.112 (a) and (b) and the following:

(a) The pipe must be of a known specification and the seam joint factor must be determined in accordance with § 195.106(e). If the specified minimum yield strength or the wall thickness is not known, it is determined in accordance with § 195.106 (b) or (c) as appropriate.

(b) There may not be any—

(1) Buckles;

(2) Cracks, grooves, gouges, dents, or other surface defects that exceed the maximum depth of such a defect permitted by the specification to which the pipe was manufactured; or

(3) Corroded areas where the remaining wall thickness is less than the minimum thickness required by the tolerances in the specification to which the pipe was manufactured.

However, pipe that does not meet the requirements of paragraph (a)(3) of this section may be used if the operating pressure is reduced to be commensurate with the remaining wall thickness.

§ 195.116 Valves.

Each valve installed in a pipeline system must comply with the following:

(a) The valve must be of a sound engineering design.

(b) Materials subject to the internal pressure of the pipeline system, including welded and flanged ends, must be compatible with the pipe or fittings to which the valve is attached.

(c) Each part of the valve that will be in contact with the hazardous liquid stream must be made of materials that are compatible with each hazardous liquid that it is anticipated will flow through the pipeline system.

(d) Each valve must be both hydrostatically shell tested and hydrostatically seat tested without leakage to at least the requirements set forth in section 5 of API Standard 6D.

(e) Each valve other than a check valve must be equipped with a means for clearly indicating the position of the valve (open, closed, etc.).

(f) Each valve must be marked on the body or the nameplate, with at least the following:

(1) Manufacturer's name or trademark.

(2) Class designation or the maximum working pressure to which the valve may be subjected.

(3) Body material designation (the end connection material, if more than one type is used).

(4) Nominal valve size.

§ 195.118 Fittings.

(a) Butt-welding type fittings must meet the marking end preparation and the bursting strength requirements of ANSI B16.9 or MSS Standard Practice SP-75.

(b) There may not be any buckles, dents, cracks, gouges, or other defects in the fitting that might reduce the strength of the fitting.

(c) The fitting must be suitable for the intended service and be at least as strong as the pipe and other fittings in the pipeline system to which it is attached.

§ 195.120 Changes in direction: Provision for internal passage.

Each component of a main line system, other than manifolds, that change direction within the pipeline system must have a radius of turn that readily allows the passage of pipeline scrapers, spheres, and internal inspection equipment.

§ 195.122 Fabricated branch connections.

Each pipeline system must be designed so that the addition of any fabricated branch connections will not reduce the strength of the pipeline system.

§ 195.124 Closures.

Each closure to be installed in a pipeline system must comply with the ASME Boiler and Pressure Vessel Code, section VIII, Pressure Vessels, Division 1, and must have pressure and temperature ratings at least equal to those of the pipe to which the closure is attached.

§ 195.126 Flange connection.

Each component of a flange connection must be compatible with each other component and the connection as a unit must be suitable for the service in which it is to be used.

§ 195.128 Station piping.

Any pipe to be installed in a station that is subject to system pressure must meet the applicable requirements of this subpart.

§ 195.130 Fabricated assemblies.

Each fabricated assembly to be installed in a pipeline system must meet the applicable requirements of this subpart.

§ 195.132 Above ground breakout tanks.

Each above ground breakout tank must be designed to withstand the internal pressure produced by the hazardous liquid to be stored therein and any anticipated external loads.

Subpart D—Construction

§ 195.200 Scope.

This subpart prescribes minimum requirements for constructing new pipeline systems with steel pipe, and for relocating, replacing, or otherwise changing existing pipeline systems that are constructed with steel pipe. However, this subpart does not apply to the movement of pipe covered by § 195.424.

§ 195.202 Compliance with specifications or standards.

Each pipeline system must be constructed in accordance with comprehensive written specifications or standards that are consistent with the requirements of this part.

§ 195.204 Inspection—general.

Inspection must be provided to ensure the installation of pipe or pipeline systems in accordance with the requirements of this subpart. No person may be used to perform inspections unless that person has been trained and is qualified in the phase of construction he is to inspect.

§ 195.206 Material inspection.

No pipe or other component may be installed in a pipeline system unless it has been visually inspected at the site of installation to ensure that it is not damaged in a manner that could impair its strength or reduce its serviceability.

§ 195.208 Welding of supports and braces.

Supports or braces may not be welded directly to pipe that will be operated at a pressure of more than 100 p.s.i.g.

§ 195.210 Pipeline location.

(a) Pipeline right-of-way must be selected to avoid, as far as practicable, areas containing private dwellings, industrial buildings, and places of public assembly.

(b) No pipeline may be located within 50 feet of any private dwelling, or any industrial building or place of public assembly in which persons work, congregate, or assemble, unless it is provided with at least 12 inches of cover in addition to that prescribed in § 195.248.

§ 195.212 Bending of pipe.

(a) Pipe must not have a wrinkle bend.

(b) Each field bend must comply with the following:

(1) A bend must not impair the serviceability of the pipe.

(2) Each bend must have a smooth contour and be free from buckling, cracks, or any other mechanical damage.

(3) On pipe containing a longitudinal weld, the longitudinal weld must be as near as practicable to the neutral axis of the bend unless-

(i) The bend is made with an internal bending mandrel; or

(ii) The pipe is 12 inches or less in outside diameter or has a diameter to wall thickness ratio less than 70.

(c) Each circumferential weld which is located where the stress during bending causes a permanent deformation in the pipe must be nondestructively tested either before or after the bending process.

§ 195.214 Welding: General.

(a) Welding must be performed in compliance with this section and §§ 195.218 through 195.234.

(b) Welding must be performed in accordance with established written welding procedures that have been tested to assure that they will produce sound, ductile welds that comply with requirements of this subpart. Detailed records of these tests must be kept by the operator involved.

§ 195.216 Welding: Miter joints.

A miter joint is not permitted (not including deflections up to 3 degrees that are caused by misalignment).

§ 195.220 Welds: Filler metal.

Filler metal must be at least equal in strength to the highest specified minimum yield strength of the pieces being welded and must fuse the pieces together.

§ 195.222 Welders: Testing.

Each welder must be qualified in accordance with section 3 of API Standard 1104, except that a welder qualified under an earlier edition of API 1104 previously listed in § 195.3 may weld but may not requalify under that earlier edition.

§ 195.224 Welding: Weather.

Welding must be protected from weather conditions that would impair the quality of the completed weld.

§ 195.226 Welding: Arc burns.

(a) Each arc burn must be repaired.

(b) An arc burn may be repaired by completely removing the notch by grinding, if the grinding does not reduce the remaining wall thickness to less than the minimum thickness required by the tolerances in the specification to which the pipe is manufactured. If a notch is not repairable by grinding, a cylinder of the pipe containing the entire notch must be removed.

(c) A ground may not be welded to the pipe or fitting that is being welded.

§ 195.228 Welds and welding inspection: Standards of acceptability.

(a) Each weld and welding must be inspected to insure compliance with the requirements of this subpart. Visual inspection must be supplemented by nondestructive testing.

(b) The acceptability of a weld is determined according to the standards in section 6 of API Standard 1104.

§ 195.230 Welds: Repair of defects.

(a) Except as provided in paragraph (b) of this section, a weld that is found unacceptable under § 195.228 may not be repaired unless—

(1) There are no cracks in the weld;

(2) The segment of the weld to be repaired was not previously repaired; and

(3) The weld is inspected after repair to assure its acceptability.

(b) In the case of offshore pipelines, a weld on a pipeline being installed from a pipelay vessel may be repaired if the repair is made in accordance with established written welding procedures that have been tested under § 195.214 to assure that they will produce sound ductile welds.

§ 195.232 Welds: Removal of defects.

Except for offshore pipelines being installed from a pipelay vessel, a cylinder of the pipe containing the weld must be removed and the ends rebeveled whenever—

(a) The weld contains one or more cracks;

(b) The weld is not acceptable under § 195.228 and is not repaired; or

(c) The weld was repaired and the repair did not meet the requirements of § 195.228.

§ 195.234 Welds: Nondestructive testing and retention of testing records.

(a) A weld may be nondestructively tested by any process that will clearly indicate any defects that may affect the integrity of the weld.

(b) Any nondestructive testing of welds must be performed—

(1) In accordance with a written set of procedures for nondestructive testing; and

(2) With personnel that have been trained in the established procedures and in the use of the equipment employed in the testing.

(c) Procedures for the proper interpretation of each weld inspection must be established to ensure the acceptability of the weld under § 195.228.

(d) During construction, at least 10 percent of the girth welds made by each welder during each welding day must be nondestructively tested over the entire circumference of the weld.

(e) In the following locations, 100 percent of the girth welds must be nondestructively tested:

(1) At any onshore location where a loss of hazardous liquid could reasonably be expected to pollute any stream, river, lake, reservoir, or other body of water, and any offshore area unless impracticable, in which case only 90 percent of each day's welds need be tested.

(2) Within railroad or public road rights-of-way.

(3) At overhead road crossings and within tunnels.

(4) At pipeline tie-ins.

(5) Within the limits of any incorporated subdivision of a State government.

(6) Within populated areas, including but not limited to, residential subdivisions, shopping centers, schools, designated commercial areas, industrial facilities, public institutions, and places of public assembly.

(f) When installing used pipe, 100 percent of the old girth welds must be nondestructively tested.

(g) A record of the nondestructive testing must be retained by the operator who is involved, including (if radiography is used) the developed film with, so far as practicable, the location of the weld. This record must be retained for 3 years after the line is placed in operation.

§ 195.236 External corrosion protection.

Each component in the pipeline system must be provided with protection against external corrosion.

§ 195.238 External coating.

(a) No pipeline system component may be buried or submerged unless that component has an external protective coating that—

(1) Is designed to mitigate corrosion of the buried or submerged component;

(2) Has sufficient adhesion to the metal surface to prevent underfilm migration of moisture;

(3) Is sufficiently ductile to resist cracking;

(4) Has enough strength to resist damage due to handling and soil stress; and

(5) Supports any supplemental cathodic protection.

In addition, if an insulating-type coating is used it must have low moisture absorption and provide high electrical resistance.

(b) All pipe coating must be inspected just prior to lowering the pipe into the ditch or submerging the pipe, and any damage discovered must be repaired.

§ 195.242 Cathodic protection system.

(a) A cathodic protection system must be installed for all buried or submerged facilities to mitigate corrosion that might result in structural failure. A test procedure must be developed to determine whether adequate cathodic protection has been achieved.

(b) A cathodic protection system must be installed not later than 1 year after completing the construction.

§ 195.244 Test leads.

(a) Except for offshore pipelines, electrical test leads used for corrosion control or electrolysis testing must be installed at intervals frequent enough to obtain electrical measurements indicating the adequacy of the cathodic protection.

(b) Test leads must be installed as follows:

(1) Enough looping or slack must be provided to prevent test leads from being unduly stressed or broken during backfilling.

(2) Each lead must be attached to the pipe so as to prevent stress concentration on the pipe.

(3) Each lead installed in a conduit must be suitably insulated from the conduit.

§ 195.246 Installation of pipe in a ditch.

(a) All pipe installed in a ditch must be installed in a manner that minimizes the introduction of secondary stresses and the possibility of damage to the pipe.

(b) All offshore pipe in water at least 12 feet deep but not more than 200 feet deep, as measured from the mean low tide, must be installed so that the top of the pipe is below the natural bottom unless the pipeline is supported by stanchions, held in place by anchors or heavy concrete coating, or an equivalent level of protection is provided.

§ 195.248 Cover over buried pipeline.

(a) Unless specifically exempted in this subpart, all pipe must be buried so that is it below the level of cultivation. Except as provided in paragraph (b) of this section, the pipe must be installed so that the cover between the top of the pipe and the ground level, road bed, river bottom, or sea bottom, as applicable, complies with the following table:

Location	Cover (inches)	
	For normal excavation	For rock excavation [1]
Industrial, commercial, and residential areas	36	30
Crossings of inland bodies of water with a width of at least 100 ft from high water mark to high water mark	48	18
Drainage ditches at public roads and railroads	36	36
Deepwater port safety zone	48	24
Other offshore areas under water less than 12 ft-deep as measured from the mean low tide	36	18
Any other area	30	18

[1] Rock excavation is any excavation that requires blasting or removal by equivalent means.

(b) Less cover than the minimum required by paragraph (a) of this section and § 195.210 may be used if—

(1) It is impracticable to comply with the minimum cover requirements; and

(2) Additional protection is provided that is equivalent to the minimum required cover.

§ 195.250 Clearance between pipe and underground structures.

Any pipe installed underground must have at least 12 inches of clearance between the outside of the pipe and the extremity of any other underground structure, except that for drainage tile the minimum clearance may be less than 12 inches but not less than 2 inches. However, where 12 inches of clearance is impracticable, the clearance may be reduced if adequate provisions are made for corrosion control.

§ 195.252 Backfilling.

Backfilling must be performed in a manner that protects any pipe coating and provides firm support for the pipe.

§ 195.254 Above ground components.

(a) Any component may be installed above ground in the following situations, if the other applicable requirements of this part are complied with:

(1) Overhead crossings of highways, railroads, or a body of water.

(2) Spans over ditches and gullies.

(3) Scraper traps or block valves.

(4) Areas under the direct control of the operator.

(5) In any area inaccessible to the public.

(b) Each component covered by this section must be protected from the forces exerted by the anticipated loads.

§ 195.256 Crossing of railroads and highways.

The pipe at each railroad or highway crossing must be installed so as to adequately withstand the dynamic forces exerted by anticipated traffic loads.

§ 195.258 Valves: General.

(a) Each valve must be installed in a location that is accessible to authorized employees and that is protected from damage or tampering.

(b) Each submerged valve located offshore or in inland navigable waters must be marked, or located by conventional survey techniques, to facilitate quick location when operation of the valve is required.

§ 195.260 Valves: Location.

A valve must be installed at each of the following locations:

(a) On the suction end and the discharge end of a pump station in a manner that perimts isolation of the pump station equipment in the event of an emergency.

(b) On each line entering or leaving a breakout storage tank area in a manner that permits isolation of the tank area from other facilities.

(c) On each mainline at locations along the pipeline system that will minimize damage or pollution from accidental hazardous liquid discharge, as appropriate for the terrain in open country, for offshore areas, or for populated areas.

(d) On each lateral takeoff from a trunk line in a manner that permits shutting off the lateral without interrupting the flow in the trunk line.

(e) On each side of a water crossing that is more than 100 feet wide from high-water mark to high-water mark unless the Secretary finds in a particular case that valves are not justified.

(f) On each side of a reservoir holding water for human consumption.

§ 195.262 Pumping equipment.

(a) Adequate ventilation must be provided in pump station buildings to prevent the accumulation of hazardous vapors. Warning devices must be installed to warn of the presence of hazardous vapors in the pumping station building.

(b) The following must be provided in each pump station:

(1) Safety devices that prevent overpressuring of pumping equipment, including the auxiliary pumping equipment within the pumping station.

(2) A device for the emergency shutdown of each pumping station.

(3) If power is necessary to actuate the safety devices, an auxiliary power supply.

(c) Each safety device must be tested under conditions approximating actual operations and found to function properly before the pumping station may be used.

(d) Except for offshore pipelines pumping equipment may not be installed—

(1) On any property that will not be under the control of the operator; or

(2) Less than 50 feet from the boundary of the station.

(e) Adequate fire protection must be installed at each pump station. If the fire protection system installed requires the use of pumps, motive power must be provided for those pumps that is separate from the power that operates the station.

§ 195.264 Above ground breakout tanks.

For above ground breakout tanks—

(a) A means must be provided for containing hazardous liquids in the event of spillage or tank failure.

(b) Tank areas must be adequately protected against unauthorized entry.

(c) Normal and emergency relief venting must be provided for each tank.

§ 195.266 Construction records.

A complete record that shows the following must be maintained by the operator involved for the life of each pipeline facility:

(a) The total number of girth welds and the number nondestructively tested, including the number rejected and the disposition of each rejected weld.

(b) The amount, location; and cover of each size of pipe installed.

(c) The location of each crossing of another pipeline.

(d) The location of each buried utility crossing.

(e) The location of each overhead crossing.

(f) The location of each valve, weighted pipe, corrosion test station, or other item connected to the pipe.

Subpart E—Hydrostatic Testing

§ 195.300 Scope.

This subpart prescribes minimum requirements for hydrostatic testing of newly constructed steel pipeline systems; existing steel pipeline systems that are relocated, replaced, or otherwise changed; and onshore steel pipeline systems constructed before January 8, 1971, that transport highly volatile liquids. However, this subpart does not apply to movement of pipe covered by § 195.424.

§ 195.302 General requirements.

(a) Each new pipeline system, each pipeline system in which pipe has been relocated or replaced, or that part of a pipeline system that has been relocated or replaced, must be hydrostatically tested in accordance with this subpart without leakage.

(b) No person may transport a highly volatile liquid in an onshore steel pipeline constructed before January 8, 1971, unless the pipeline has been hydrostatically tested in accordance with this subpart or, except for pipelines subject to § 195.5, its maximum operating pressure is established under § 195.406(a)(5). Pipelines that were in highly volatile liquid service before September 8, 1980 must meet this requirement according to the following schedule:

(1) Planning and scheduling of hydrostatic testing or actual reduction in maximum operating pressure to meet § 195.406(a)(5) must be completed before Sept. 15, 1981; and

(2) Hydrostatic testing must be completed before Sept. 15, 1985, with at least 50 percent of the testing completed before Sept. 15, 1983.

(c) The test pressure for each hydrostatic test conducted under this section must be maintained throughout the part of the system being tested for at least 4 continuous hours at a pressure equal to 125 percent, or more, of the maximum operating pressure and, in the case of a pipeline that is not visually inspected for leakage during test, for at least an additional 4 continuous hours at a pressure equal to 110 percent, or more, of the maximum operating pressure.

§ 195.304 Testing of components.

(a) Each hydrostatic test under § 195.302 must test all pipe and attached fittings, including components, unless otherwise permitted by paragraph (b) of this section.

(b) A component that is the only item being replaced or added to the pipeline system need not be hydrostatically tested under paragraph (a) of this section if the manufacturer certifies that either—

(1) The component was hydrostatically tested at the factory; or

(2) The component was manufactured under a quality control system that ensures each component is at least equal in strength to a prototype that was hydrostatically tested at the factory.

§ 195.306 Test medium.

(a) Except as provided in paragraph (b) of this section, water must be used as the test medium.

(b) Except for offshore pipelines, liquid petroleum that does not vaporize rapidly may be used as the test medium if—

(1) The entire pipeline section under test is outside of cities and other populated areas;

(2) Each building within 300 feet of the test section is unoccupied while the test pressure is equal to or greater than a pressure which produces a hoop stress of 50 percent of specified minimum yield strength;

(3) The test section is kept under surveillance by regular patrols during the test; and

(4) Continuous communication is maintained along entire test section.

§ 195.308 Testing of tie-ins.

Pipe associated with tie-ins must be hydrostatically tested, either with the section to be tied in or separately.

§ 195.310 Records.

(a) A record must be made of each hydrostatic test and that record must be retained as long as the facility tested is in use.

(b) The record required by paragraph (a) of this section must include the recording gauge charts, dead weight tester data, and the reasons for any failure during a test. Where elevation differences in the section under test exceed 100 feet, a profile of the pipeline that shows the elevation and test sites over the entire length of the test section must be included. Each recording gauge chart must also contain—

(1) The operator's name, the name of the person responsible for making the test, and the name of the test company used, if any;

(2) The date and time of the test;

(3) The minimum test pressure;

(4) The test medium;

(5) A description of the facility tested; and

(6) An explanation of any pressure discontinuities that appear on any chart.

Subpart F—Operation and Maintenance

§ 195.400 Scope.

This subpart prescribes minimum requirements for operating and maintaining pipeline systems constructed with steel pipe.

§ 195.401 General requirements.

(a) No operator may operate or maintain its pipeline systems at a level of safety lower than that required by this subpart and the procedures it is required to establish under § 195.402(a) of this subpart.

(b) Whenever an operator discovers any condition that could adversely affect the safe operation of its pipeline system, it shall correct it within a reasonable time. However, if the condition is of such a nature that it presents an immediate hazard to persons or property, the operator may not operate the affected part of the system until it has corrected the unsafe condition.

(c) Except as provided in § 195.5, no operator may operate any part of a pipeline system upon which construction was begun after March 31, 1970, or in the case of offshore pipelines located between a production facility and an operator's trunkline reception point, after July 31, 1977, unless it was designed and constructed as required by this part.

§ 195.402 Procedural manual for operations, maintenance, and emergencies.

(a) *General.* Each operator shall prepare and follow for each pipeline system a manual of written procedures for conducting normal operations and maintenance activities and handling abnormal operations and emergencies. This manual shall be reviewed annually and appropriate changes made as necessary to insure that the manual is effective. This manual shall be prepared before initial operations of a pipeline system commence and appropriate parts shall be kept at locations where operations and maintenance activities are conducted.

(b) *Amendments.* If the Secretary finds that an operator's procedures are inadequate to assure safe operation of the system or to minimize hazards in an emergency, the Secretary may, after issuing a notice of amendment and providing an opportunity for an informal hearing, require the operator to amend the procedures. In determining the adequacy of the procedures, the Secretary considers pipeline safety data, the feasibility of the procedures, and whether the procedures are appropriate for the pipeline system involved. Each notice of amendment shall allow the operator at least 15 days after receipt of such notice to submit written comments or request an informal hearing. After considering all material presented, the Secretary shall notify the operator of the required amendment or withdraw the notice proposing the amendment.

(c) *Maintenance and Normal Operations.* The manual required by paragraph (a) of this section must include procedures for the following to provide safety during maintenance and normal operations:

(1) Making construction records, maps, and operating history available as necessary for safe operation and maintenance.

(2) Gathering of data needed for reporting accidents under Subpart B of this part in a timely and effective manner.

(3) Operating, maintaining, and repairing the pipeline system in accordance with each of the requirements of this subpart.

(4) Determining which pipeline facilities are located in areas that would require an immediate response by the operator to prevent hazards to the public if the facilities failed or malfunctioned.

(5) Analyzing pipeline accidents to determine their causes.

(6) Minimizing the potential for hazards identified under paragraph (c)(4) of this section and the possibility of recurrence of accidents analyzed under paragraph (c)(5) of this section.

(7) Starting up and shutting down any part of the pipeline system in a manner designed to assure operation within the limits prescribed by § 195.406, consider the hazardous liquid in transportation, variations in altitude along the pipeline, and pressure monitoring and control devices.

(8) In the case of a pipeline that is not equipped to fail safe, monitoring from an attended location pipeline pressure during startup until steady state pressure and flow conditions are reached and during shut-in to assure operation within limits prescribed by § 195.406.

(9) In the case of facilities not equipped to fail safe that are identified under § 195.402(c)(4) or that control receipt and delivery of the hazardous liquid, detecting abnormal operating conditions by monitoring pressure, temperature, flow or other appropriate operational data and transmitting this data to an attended location.

(10) Abandoning pipeline facilities, including safe disconnection from an operating pipeline system, purging of combustibles, and sealing abandoned facilities left in place to minimize safety and environmental hazards.

(11) Minimizing the likelihood of accidental ignition of vapors in areas near facilities identified under paragraph (c)(4) of this section where the potential exists for the presence of flammable liquids or gases.

(12) Establishing and maintaining liaison with fire, police, and other appropriate public officials to learn the responsibility and resources of each government organization that may respond to a hazardous liquid pipeline emergency and acquaint the officials with the operator's ability in responding to a hazardous liquid pipeline

emergency and means of communication.

(13) Periodically reviewing the work done by operator personnel to determine the effectiveness of the procedures used in normal operation and maintenance and taking corrective action where deficiencies are found.

(d) *Abnormal Operation.* The manual required by paragraph (a) of this section must include procedures for the following to provide safety when operating design limits have been exceeded:

(1) Responding to, investigating, and correcting the cause of:

(i) Unintended closure of valves or shutdowns;

(ii) Increase or decrease in pressure or flow rate outside normal operating limits;

(iii) Loss of communications;

(iv) Operation of any safety device;

(v) Any other malfunction of a component, deviation from normal operation, or personnel error which could cause a hazard to persons or property.

(2) Checking variations from normal operation after abnormal operation has ended at sufficient critical locations in the system to determine continued integrity and safe operation.

(3) Correcting variations from normal operation of pressure and flow equipment and controls.

(4) Notifying responsible operator personnel when notice of an abnormal operation is received.

(5) Periodically reviewing the response of operator personnel to determine the effectiveness of the procedures controlling abnormal operation and taking corrective action where deficiencies are found.

(e) *Emergencies.* The manual required by paragraph (a) of this section must include procedures for the following to provide safety when an emergency condition occurs:

(1) Receiving, identifying, and classifying notices of events which need immediate response by the operator or notice to fire, police, or other appropriate public officials and communciating this information to appropriate operator personnel for corrective action.

(2) Prompt and effective response to a notice of each type emergency, including fire or explosion occurring near or directly involving a pipeline facility accidental release of hazardous liquid from a pipeline facility, operational failure causing a hazardous condition, and natural disaster affecting pipeline facilities.

(3) Having personnel, equipment, instruments, tools, and material available as needed at the scene of an emergency.

(4) Taking necessary action, such as emergency shutdown, or pressure reduction, to minimize the volume of hazardous liquid that is released from any section of a pipeline system in the event of a failure.

(5) Control of released hazardous liquid at an accident scene to minimize the hazard, including possible intentional ignition in the cases of flammable highly volatile liquid.

(6) Minimization of public exposure to injury and probability of accidental ignition by assisting with evacuation of residents and assisting with halting traffic on roads and railroads in the affected area, or taking other appropriate action.

(7) Notifying fire, police, and other appropriate public officials of hazardous liquid pipeline emergencies and coordinating with them preplanned and actual responses during an emergency, including additional precautions necessary for an emergency involving a pipeline system transporting a highly volatile liquid.

(8) In the case of failure of a pipeline system transporting a highly volatile liquid, use of appropriate instruments to assess the extent and coverage of the vapor cloud and determine the hazardous areas.

(9) Providing for a post accident review of employee activities to determine whether the procedures were effective in each emergency and taking corrective action where deficiencies are found.

§ 195.403 Training.

(a) Each operator shall establish and conduct a continuing training program to instruct operating and maintenance personnel to:

(1) Carry out the operating and maintenance, and emergency proce-

dures established under § 195.402 that relate to their assignments;

(2) Know the characteristics and hazards of the hazardous liquids transported, including, in the case of flammable HVL, flammability of mixtures with air, orderless vapors, and water reactions;

(3) Recognize conditions that are likely to cause emergencies, predict the consequences of facility malfunctions or failures and hazardous liquid spills, and to take appropriate corrective action;

(4) Take steps necessary to control any accidental release of hazardous liquid and to minimize the potential for fire, explosion, toxicity, or environmental damage;

(5) Learn the proper use of firefighting procedures and equipment, fire suits, and breathing apparatus by utilizing, where feasible, a simulated pipeline emergency condition; and

(6) In the case of maintenance personnel, to safely repair facilities using appropriate special precautions, such as isolation and purging, when highly volatile liquids are involved.

(b) At intervals of not more than 1 year each operator shall:

(1) Review with personnel their performance in meeting the objectives of the training program set forth in paragraph (a) of this section; and

(2) Make appropriate changes to the training program as necessary to insure that it is effective.

(c) Each operator shall require and verify that its supervisors maintain a thorough knowledge of that portion of the procedures established under § 195.402 for which they are responsible to insure compliance.

§ 195.404 Maps and records.

(a) Each operator shall maintain current maps and records of its pipeline systems that include at least the following information:

(1) Location and identification of all major facilities.

(2) All crossings of public roads, railroads, rivers, buried utilities, and foreign pipelines.

(3) The maximum operating pressure of each pipeline.

(4) The diameter, grade, type, and nominal wall thickness of all pipe.

(b) Each operator shall maintain daily operating records that indicate the discharge pressures at each pump station and any unusual operations of a facility. The operator shall retain these records for at least 3 years.

(c) Each operator shall maintain for the useful life of that part of the pipeline system to which they relate, records that include the following:

(1) The date, location, and description of each repair made to its pipeline systems.

(2) A record of each inspection and each test required by this subpart.

§ 195.406 Maximum operating pressure.

(a) Except for surge pressures and other variations from normal operations, no operator may operate a pipeline at a pressure that exceeds any of the following:

(1) The internal design pressure of the pipe determined in accordance with § 195.106.

(2) The design pressure of any other component of the pipeline.

(3) Eighty percent of the test pressure for any part of the pipeline which has been hydrostatically tested under Subpart E of this part.

(4) Eighty percent of the factory test pressure or of the prototype test pressure for any individually installed component which is excepted from testing under § 195.304.

(5) In the case of onshore HVL pipelines constructed before January 8, 1971, that have not been tested under Subpart E of this part, 80 percent of the lost pressure or highest operating pressure to which the pipeline was subjected for four or more continuous hours that can be demonstrated by recording charts or logs made at the time the test or operations were conducted. (See § 195.302(b) for a compliance schedule for pipelines in HVL service before September 8, 1980.)

(b) No operator may pemit the pressure in a pipeline during surges or other variations from normal operations to exceed 110 percent of the operating pressure limit established under paragraph (a) of this section. Each operator must provide adequate controls and protective equipment to control the pressure within this limit.

§ 195.408 Communications.

(a) Each operator must have a communication system to provide for the transmission of information needed for the safe operation of its pipeline system.

(b) The communication system required by paragraph (a) of this section must, as a minimum, include means for:

(1) Monitoring operational data as required by § 195.402(c)(9);

(2) Receiving notices from operator personnel, the public, and public authorities of abnormal or emergency conditions and sending this information to appropriate personnel or government agencies for corrective action;

(3) Conducting two-way vocal communication between a control center and the scene of abnormal operations and emergencies; and

(4) Providing communication with fire, police, and other appropriate public officials during emergency conditions, including a natural disaster.

§ 195.410 Line markers.

(a) Except as provided in paragraphs (b) and (c) of this section, each operator shall place and maintain line markers over each buried line in accordance with the following:

(1) Markers must be located at each public road crossing, at each railroad crossing, and in sufficient number along the remainder of each buried line so that its location is accurately known.

(2) The marker must state at least the following: "Warning" followed by the words "Petroleum (or the name of the hazardous liquid transported) Pipeline" (in lettering at least 1 inch high with an approximate stroke of one-quarter inch on a background of sharply contrasting color), the name of the operator and a telephone number (including area code) where the operator can be reached at all times. Markers at navigable waterway crossings must also contain the words "Do Not Anchor or Dredge" with lettering not less than 12 inches high with an approximate stroke of 1¾ inches on a background of sharply contrasting color.

(b) Line markers are not required in heavily developed urban areas such as downtown business centers where—

(1) The placement of markers is impracticable and would not serve the purpose for which markers are intended; and

(2) The local government maintains current substructure records.

(c) Line markers that have been installed before April 1, 1970, may be used until April 1, 1975.

(d) Each operator shall provide line marking at locations where the line is above ground in areas that are accessible to the public.

§ 195.412 Inspection of rights-of-way and crossings under navigable waters.

(a) Each operator shall, at intervals not exceeding 2 weeks, inspect the surface conditions on or adjacent to each pipeline right-of-way.

(b) Except for offshore pipelines, each operator shall, at intervals not exceeding 5 years, inspect each crossing under a navigable waterway to determine the condition of the crossing.

§ 195.414 Cathodic protection.

(a) After March 31, 1973, no operator may operate a pipeline that has an external surface coating material, unless that pipeline is cathodically protected. This paragraph does not apply to breakout tank areas and buried pumping station piping.

(b) Each operator shall electrically inspect each bare pipeline before April 1, 1975, to determine any areas in which active corrosion is taking place. The operator may not increase its established operating pressure on a section of bare pipeline until the section has been so electrically inspected. In any areas where active corrosion is found, the operator shall provide cathodic protection. Section 195.416 (f) and (g) applies to all corroded pipe that is found.

(c) Each operator shall electrically inspect all breakout tank areas and buried pumping station piping before April 1, 1973, as to the need for cathodic protection, and cathodic protection shall be provided where necessary.

(d) Notwithstanding the deadlines for compliance in paragraphs (a), (b), and (c) of this section, this section does not apply to offshore pipelines located between a production facility and an operator's trunkline reception point until August 1, 1977.

§ 195.416 External corrosion control.

(a) Each operator shall, at intervals not exceeding 12 months, conduct tests on each underground facility in its pipeline systems that is under cathodic protection to determine whether the protection is adequate.

(b) Each operator shall maintain the test leads required for cathodic protection in such a condition that electrical measurements can be obtained to ensure adequate protection.

(c) Each operator shall, at intervals not exceeding 2 months, inspect each of its cathodic protection rectifiers.

(d) Each operator shall, at intervals not exceeding 5 years, electrically inspect the bare pipe in its pipeline system that is not cathodically protected and must study leak records for that pipe to determine if additional protection is needed.

(e) Whenever any buried pipe is exposed for any reason, the operator shall examine the pipe for evidence of external corrosion. If the operator finds that there is active corrosion, that the surface of the pipe is generally pitted, or that corrosion has caused a leak, it shall investigate further to determine the extent of the corrosion.

(f) Any pipe that is found to be generally corroded so that the remaining wall thickness is less than the minimum thickness required by the pipe specification tolerances must either be replaced with coated pipe that meets the requirements of this part or, if the area is small, must be repaired. However, the operator need not replace generally corroded pipe if the operating pressure is reduced to be commensurate with the limits on operating pressure specified in this subpart, based on the actual remaining wall thickness.

(g) If isolated corrosion pitting is found, the operator shall repair or replace the pipe unless—

(1) The diameter of the corrosion pits is less than the nominal wall thickness as measured at the surface of the pipe; and

(2) The remaining wall thickness at the bottom of the pits is at least 70 percent of the nominal wall thickness.

(h) Each operator shall clean, coat with material suitable for the prevention of atmospheric corrosion, and, maintain this protection for, each component in its pipeline system that is exposed to the atmosphere.

§ 195.418 Internal corrosion control.

(a) No operator may transport any hazardous liquid that would corrode the pipe or other components of its pipeline system, unless it has investigated the corrosive effect of the hazardous liquid on the system and has taken adequate steps to mitigate corrosion.

(b) If corrosion inhibitors are used to mitigate internal corrosion the operator shall use inhibitors in sufficient quantity to protect the entire part of the system that the inhibitors are designed to protect and shall also use coupons or other monitoring equipment to determine their effectiveness.

(c) The operator shall, at intervals not exceeding 6 months, examine coupons or other types of monitoring equipment to determine the effectiveness of the inhibitors or the extent of any corrosion.

(d) Whenever any pipe is removed from the pipeline for any reason, the operator must inspect the internal surface for evidence of corrosion. If the pipe is generally corroded such that the remaining wall thickness is less than the minimum thickness required by the pipe specification tolerances, the operator shall investigate adjacent pipe to determine the extent of the corrosion. The corroded pipe must be replaced with pipe that meets the requirements of this part or, based on the actual remaining wall thickness, the operating pressure must be reduced to be commensurate with the limits on operating pressure specified in this subpart.

[Amdt. 195-22, 46 FR 38360, July 27, 1981; as amended by 46 FR 38922, July 30, 1981]

§ 195.420 Value maintenance.

(a) Each operator shall maintain each value that is necessary for the safe operation of its pipeline systems in good working order at all times.

(b) Each operator shall, at intervals not exceeding 6 months, inspect each main line valve to determine that it is functioning properly.

(c) Each operator shall provide protection for each valve from unauthorized operation and from vandalism.

§ 195.422 Pipeline repairs.

(a) Each operator shall, in repairing its pipeline systems, insure that the repairs are made in a safe manner and are made so as to prevent damage to persons or property.

(b) No operator may use any pipe, valve, of fitting, for replacement in repairing pipeline facilities, unless it is designed and constructed as required by this part.

§ 195.424 Pipe movement.

(a) No operator may move any line pipe, unless the pressure in the line section involved is reduced to not more than 50 percent of the maximum operating pressure.

(b) No operator may move any pipeline containing highly volatile liquids where materials in the line section involved are joined by welding unless—

(1) Movement when the pipeline does not contain highly volatile liquids is impractical;

(2) The procedures of the operator under § 195.402 contain precautions to protect the public against the hazard in moving pipelines containing highly volatile liquids, including the use of warnings, where necessary, to evacuate the area close to the pipeline; and

(3) The pressure in that line section is reduced to the lower of the following:

(i) Fifty percent or less of the maximum operating pressure; or

(ii) The lowest practical level that will maintain the highly volatile liquid in a liquid state with continuous flow, but not less than 50 p.s.i.g. above the vapor pressure of the commodity.

(c) No operator may move any pipeline containing highly volatile liquids where materials in the line section involved are not joined by welding unless—

(1) The operator complies with paragraphs (b) (1) and (2) of this section; and

(2) That line section is isolated to prevent the flow of highly volatile liquid.

[Amdt. 195-22, 46 FR 38360, July 27, 1981; 46 FR 38922, July 30, 1981]

§ 195.426 Scraper and sphere facilities.

No operator may use a launcher or receiver that is not equipped with a relief device capable of safely relieving pressure in the barrel before insertion or removal or scrapers or spheres. The operator must use a suitable device to indicate that pressure has been relieved in the barrel or must provide a means to prevent insertion or removal of scrapers or spheres if pressure has not been relieved in the barrel.

§ 195.428 Overpressure safety devices.

(a) Except as provided in paragraph (b) of this section, each operator shall, at intervals not exceeding 12 months, or 6 months in the case of pipelines used to carry highly volatile liquids, inspect and test each pressure limiting device, relief valve, pressure regulator, or other item of pressure control equipment to determine that it is functioning properly, is in good mechanical condition, and is adequate from the standpoint of capacity and reliability of operation for the service in which it is used.

(b) In the case of relief valves on pressure breakout tanks containing highly volatile liquids, each operator shall test each valve at intervals not exceeding 5 years.

§ 195.430 Firefighting equipment.

Each operator shall maintain adequate firefighting equipment at each pump station and breakout tank area. The equipment must be—

(a) In proper operating condition at all times;

(b) Plainly marked so that its identity as firefighting equipment is clear; and

(c) Located so that it is easily accessible during a fire.

§ 195.432 Breakout tanks.

Each operator shall, at intervals not exceeding 12 months, inspect each breakout tank (including atmospheric and pressure tanks).

§ 195.434 Signs.

Each operator shall maintain signs visible to the public around each pumping station and breakout tank area. Each sign must contain the name of the operator and an emergency telephone number to contact.

§ 195.436 Security of facilities.

Each operator shall provide protection for each pumping station and breakout tank area and other exposed facility (such as scraper traps) from vandalism and unauthorized entry.

§ 195.438 Smoking or open flames.

Each operator shall prohibit smoking and open flames in each pump station area and each breakout tank area where there is a possibility of the leakage of a flammable hazardous liquid or of the presence of flammable vapors.

§ 195.440 Public education.

Each operator shall establish a continuing educational program to enable the public, appropriate government organizations, and persons engaged in excavation related activities to recognize a hazardous liquid pipeline emergency and to report it to the operator or the fire, police, or other appropriate public officials. The program must be conducted in English and in other languages commonly understood by a significant number and concentration of non-English speaking population in the operator's operating areas.

PARTS 196-199—[RESERVED]

FINDING AIDS

A list of CFR titles, subtitles, chapters, subchapters and parts and an alphabetical list of agencies publishing in the CFR are included in the CFR Index and Finding Aids volume to the Code of Federal Regulations which is published separately and revised semiannually (January 1 and July 1).

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49 CFR CHAPTER I (PARTS 100-189)

RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION, DEPARTMENT OF TRANSPORTATION (HAZARDOUS MATERIALS REGULATIONS)

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1430 Broadway, New York, NY 10018

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2101 L St. NW., Washington, DC 20037

211 North Ervay, Suite 1700, Dallas, Texas 75201

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5360 South Workman Hill Road, Whittier, CA 90601

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5203 Leesburg Pike, Suite 502, Falls Church, VA 22041

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470 Atlantic Ave., Boston, MA 02210

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Redesignation Table

Effective April 1, 1967 (32 FR 5606, Apr. 5, 1967), the following parts of Title 49 of the Code of Federal Regulations were transferred from the Interstate Commerce Commission to the Department of Transportation:

Part(s)	Part(s)
170–190	239
191	290–298

The remaining regulations of the Interstate Commerce Commission were transferred from Chapter I of 49 CFR to Chapter X of that title and were redesignated and republished as set forth below. The following table shows the relationship between the ICC regulations prior to redesignation with the regulations contained in Chapter X.

Former part (or section) number	Redesignated part (or section) number
195	1033
197	1034

The regulations of the Department of Transportation contained in Title 49 Parts 100 to 999 were reorganized and redesignated at 33 FR 19602, Dec. 25, 1968. In addition, the regulations of the Federal Highway Administration contained in Title 23, Chapter II, were transferred to Title 49.

The following table shows the relationship between the old part numbers and the redesignated part numbers of Title 49.

New Part number	Old Part number
170–190	No change
230	191

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List of CFR Sections Affected

All changes in this volume of the Code of Federal Regulations which were made by documents published in the FEDERAL REGISTER since January 1, 1973, are enumerated in the following list. Entries indicate the nature of the changes effected. Page numbers refer to FEDERAL REGISTER pages. The user should consult the entries for chapters and parts as well as sections for revisions.

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NOTE: Symbol (†) refers to 1975 page numbers.

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179.101-1 (a) footnote 12 added	Δ21476
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